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ELECTRICAL EXPORTS FOR THE YEAR.

With the issuance of the detailed statistics for June, we get the complete year of electrical reports, and a very excellent showing it is. The total export of electrical machinery for 1905, in the twelve months, was $7,290,932 as compared with $5,645,809 last year, and $5,779,459 in 1903. The gain over last year is large and well distributed, Japan coming in for nearly $500,000 of it, and Mexico for about $350,000. These two countries took no less than $2,316,942 of electrical machinery in 1905, or very nearly one-third of the total. Our next best customers were British North America, $1,711,981, and the United Kingdom, $1,088,961. Turning to electrical instruments we find another gain, though not quite so large, the total being $4,962,972 in 1905, as compared with $4,861,204 in 1904, and $4,206,617 in 1903. As will be seen the gain is $100,000 over last year, and $750,000 over 1903. If the exports of electrical machinery and instruments be added together, the respectable total of no less than $12,253,904 is reached. This is at the rate of over one million dollars a month. We believe that with persistence and well-directed effort this could be increased to two and three times as much. The general world consumption of electrical apparatus has barely begun, and customers await in all parts of the globe,

DIRT VS. ILLUMINATION.

There is probably no greater enemy to the efficient use of electric light than the dirt which accumulates in a short time on all the bulbs, globes and reflectors in the down town districts of our large cities. It is not enough that some of the energy in the coal must be lost up the chimney in the shape of smoke and soot, but some of this unconsumed carbon, after having escaped at the steam boiler end of the transformation of energy, must, forsooth, go and attach itself to the incandescent lamp bulb in a final attempt to defeat the efforts of man to transform the energy of coal into light. However, it is not usually the electric light plant chimney which is the offender in the production of smoke, but the multitude of small chimneys. Seriously, it is not an uncommon thing in large cities, where soft coal is the common fuel, to see 50 per cent of the light wasted on account of an unnoticed coating of dirt on lamp and reflector. This is more likely to be true of lamps on high chandeliers and fixtures than those where close inspection and cleaning can be effected easily by the user. However, it is not our mission to preach cleanliness or godliness to the general public. The desirability of both is admitted. The point to be considered by engineers and architects is that dirt is likely to collect, and this should be one of the things taken into consideration in planning the illumination of any building.

There are many places where the illuminating engineer must plan to avoid the glare of the bare incandescent lamp filament and where some diffusing bulb or globe must be employed. Unfortunately, the most efficient diffusing coverings that can be placed over a lamp are usually the worst dirt-catchers. It almost seems sometimes as if the dirt-catching ability of a globe were in direct proportion to its desirability in other ways, so that, while the efficiency when new may be very high, it will in dirty locations be very low on the average unless the user of the light keeps after the globe religiously with a stiff brush and an occasional thorough bath in soap and water. Next after the above type of globe in initial efficiency, when kept clean,

come the sand-blasted and frosted or ground-glass globes, which are also excellent as diffusers and softeners of the light. Ground or sand-blasted glass is not likely to collect much dirt without its being noticed on account of the whiteness of the ground surface. The worst thing about this glass is the difficulty of ever getting the dirt off the rough surface. For this reason it is usually advisable, when selecting ground glass as a diffuser, to use frosted bulb lamps instead of globes. As the lamps are renewed every few hundred hours, the chances for great loss of efficiency by dirt are not as great as they would be with a ground glass surrounding globe which must remain up permanently and which when once dirty must remain so. The initial efficiency will also be higher with the frosted bulb than with a clear glass bulb surrounded with a globe. Of course, by using a surrounding globe with the frosting or sand blasting inside and proper means for closing the top of the globe around the shade holder, such globes can be kept reasonably clean for a number of years. This can only be done, however, where a good dust-tight gasket is used on the globe-holder. We can, to be sure, employ globes of the opal and similar classes which are perfectly smooth and can be perfectly clean; but with most of these globes there is more loss by absorption than with either the ground glass or holophane. Furthermore, these globes are not as good diffusers of the intense light from a filament.

The best that the illuminating engineer can do is to make a selection which he thinks will give the highest average efficiency under the assumable working conditions. The probability that dirt will collect will usually lead him to place lights as far as possible in locations where they are above the line of ordinary vision and, diffusing globes are not necessary. When this is done, instead of enclosing globes, open reflectors can be used which are easily cleaned, easily show dirt, so that they are likely to be cleaned, and give an all around higher efficiency than enclosing diffusing globes. Now that preparations will soon be made for the active fall season, some of our readers in the lighting field may find profit in testing these suggestions. In any case, however, the factor of cleanliness cannot be neglected, and in many instances a system of care-taking by which cleanliness can be maintained to a considerable degree will result in an efficiency as high or higher than may be obtained by replacing present globes by others intrinsically preferable but to which proper attention will not be given. As in all questions where several factors enter, the best solution is only afforded after a consideration of all the factors, and in maintaining an illuminating system the light absorbing property of dirt should not be held too homely a subject for thought and remedy.

THE ADVENT OF THE GAS ENGINE.

We are glad to present to our readers some further account, from Mr. John Martin, of the remarkable gas engine installation of the California Gas & Electric Company, now nearing completion. After all the discussion pro and con regarding large gas engines, and all the information accumulated here and abroad it has remained once more for our brethren on the Coast to get up and act. While Eastern engineers have dubiously wagged their heads and mourned over problems of lubrication or proved to their own satisfaction that depreciation's doleful drain would make gas engines too expensive, the energetic Coast contingent has been getting busy, as is its wont, upon a startling scale. In this instance the choice of gas engines was not primarily so much a matter of economy as of necessity, although it is believed that economy will result. The case in hand was the suppply of power to the United Railroads of San Francisco, without risk of a tie-up on account of trouble on the lines. Although the electric service over the 140-mile line that separates the nearest transmission plant from San Francisco has been remarkably free from interruptions, thanks to the numerous sources of power, the chance of a shutdown on the railways was so serious a contingency that the risk could not be assumed. Nor would a steam auxiliary be adequate unless steam were always up, which would mean prohibitive cost. So after mature deliberation it was determined to take the bold step of installing a huge auxiliary plant driven by gas engines.

Contracts were therefore closed for three direct-connected units, gas engine driven and each capable of delivering 4,000 kw; and this equipment is now nearing completion so that it is expected to be in operation by the first of next year. The engines, aside from their great size, involve some features sufficiently unusual to be of great interest. In the first place they are twin, tandem, double acting engines, so that each crank gets two impulses per revolution while the engines are still running on the ordinary four-cycle scheme. The lubrication is accomplished by feeding the oil to each cylinder at four points by independent pumps during the inhalation stroke. The subsequent compression stroke spreads the oil so that on the power stroke the piston finds its path thoroughly oiled. Another feature of the design which particularly appeals is the sectional jacketing of the cylinders so that a temperature gradient can be established in the cylinder in such wise as to keep down unnecessary losses from the cooling. No details of the governor are accessible, but with two impulses per revolution it should be possible to secure pretty good results, helped on by the 65-ton flywheel. Each complete generating unit, it should be mentioned, weighs 600 tons. The gas to be used is oil gas made from California crude oil. Not only will these units be used as an emergency reserve for the railway service, but they will be regularly employed in connection with the great transmission system in trying to build up the load factor which represents earning capacity. They will thus earn their keep richly even if, as seems probable, they will seldom be called on as a safety reserve.

Now all this is a serious matter for consideration. From report, the guarantees of these engines are of a character that will prove surprising if lived up to. And there is no good reason to suppose that they will not be. Once they are successfully in operation, the value of a gas engine reserve will soon be made manifest. In the matter of convenience, the gas engine is in a class quite by itself. It can be called into action in a couple of minutes, and unless all signs fail can produce power at a very low rate. We will not here attempt to discuss the relative cost of power produced by gas engines and steam engines; indeed the advocates of each have thus far failed to get upon a common ground of discussion, each flatly denying the facts taken for granted by the other. But it is perfectly clear that if the big gas engine can operate at the cost claimed for it, or anywhere near that cost, the steam engine has to take the losing end of the game. To beat out the gas engine on the data now at hand one must deliberately take the position that these data have been misread or falsified; and that is pretty dangerous ground. The operation of these big San Francisco engines will go far toward settling many mooted questions of cost if the operating data are made public, as we hope they will be. It would be a strange freak of fate if the recent improvements in steam practice should turn out to have been made just too late. Even at nearly equal costs, the gas engine has the advantage of quick availability, a feature which goes far to offset its relatively low economy when underloaded. At all events, used as it is proposed in San Francisco, to hold up the load factor, there will be no excuse whatever for running on light

loads. We are certainly getting near to revelations on the subject of gas engines, and the engineering public will watch with the keenest interest for reports from this great pioneer plant, for such it is as regards the larger aspects of the case.

ELECTRIC WAVES AND MAXWELL'S ETHER.

The July number of the *Journal* of the Franklin Institute contains a paper, by Prof. W. S. Franklin, which embodies a discussion of electric wave propagation from the standpoint of Maxwell's electromechanical theory of the universal ether. The universal ether has never possessed any experimental right to exist. No one has ever yet seen, felt, or tasted it. It is probably correct to say that there is not a single observation, or recorded experiment, which brings the ether home to our senses as ether. Nevertheless, we all believe that it exists, because our minds cannot grasp action across a void, and in order to make our mental conceptions work, we are obliged to create a something out of nothing. We cannot imagine, for example, that the sun's light, which we know by observation takes about 500 seconds to reach our planet, "does time" in empty space, or spends these 8 minutes in nothing—doing nothing. Again, the space within a highly exhausted glass tube cannot, in our minds, be regarded as empty of everything; for if we place the tube inside an electrically excited solenoid, we can ascertain that magnetic energy exists in the tube. We are unable to think that magnetic energy can exist in nothing. To meet these and numerous like difficulties, the ether has been invented.

Once having adopted the ether, its duties develop at an astonishing rate. It has to fill all space, or stretch out to infinity in all directions, without any holes or blank cavities. It must permeate all substances to the innermost, more thoroughly even than water permeates a submerged sponge. The motion of matter must give rise to no displacement in the permeating or environing ether. The ether must be capable of absorbing electric and magnetic energy, and of transmitting gravitational stresses. Electromagnetic energy must be propagated through it at a uniform and definite speed. All of these properties must be everywhere the same; to ranges of billions of miles, so that the ether in which the earth floats next year must be, within measurable limits, identical in behavior to the ether in which the planet floats to-day, for the entire solar system is supposed to shift its position in space by half a billion miles per annum. It must be admitted that an ether which can do all this is a very remarkable entity. Speculations as to what it can be like have been ripe for many decades. Some estimated that it was jelly-like. Others preferred to suppose it made up of distinct grains like extremely small shot. The astronomer wanted one kind and the electrician wanted another. Some scientists postulated for it a rigidity much greater than that of steel, together with a tenuity much below that of the rarefied gases in a Crookes tube.

Clark Maxwell ascertained that the numerical properties of electric wave propagation through space were parallel with, or similar to, the properties of wave propagation in a jelly-like elastic fluid. He invented a mechanical kind of ether which would transmit electric waves like those of light. He imagined all space to be filled with ether-cells like minute marbles. These marbles are alternatively positive and negative, in such a regular organized manner that only oppositely signed cells are in contact. There is no mechanical friction between all these cells filling up the universe; but if any one cell is rotated about its center, all of the neighboring oppositely signed cells in contact with it will also move, as though geared by cogs. A magnetic field is a region in which these ether cells are all rotating, the positives one way and the negatives the other. An electric field is a region in which the positive and negative cells are elastically displaced with reference to each other. Assuming then that the cells have mass and inertia, the properties of electric waves and their propagation can be discovered in the ideal mechanical model ether thus organized. It may be permitted any honest man to doubt the existence of this cog-sphere ether, without being guilty of heresy. We do not suppose that Maxwell ever believed that the ether was built up of alternate positive and negative cog-spheres. As to the real nature of the ether, we are as much in the dark as ever. But if the Maxwell theory offers an ideal machine whose actions can be followed in imagination to a final result, which is the same as that of the actual but unknown machinery, we are justified in using the ideal mechanism merely to assist our ideas. It does not follow that because we consider the actual mechanism is different from the ideal mechanism, we must avoid all use of the latter as a tool. This is Prof. Franklin's position as we understand it.

The article develops the cog-sphere theory to account for the behavior of electric waves over wires, and finds help from the mechanical actions of the systems constructed. The particular value of a mechanical working theory in such inquiries is, however, an individual matter, like æsthetics. What will best aid and satisfy one mind, will not necessarily be most acceptable to another. For example, the theory of electromagnetic waves developed in the works of J. J. Thomson is mathematically equivalent to the cog-sphere theory, but accomplishes the result by purely symbolic methods. One of the salient peculiarities of either the Maxwellian cog-sphere theory, or of any of the methematical theories of electricity, is that whereas an electric stress can be pushed through free space, or through a dielectric space, it cannot be exerted through a conductor. This means, according to the modern views of matter, that whereas an electric stress may be excited through the ether, it fails to pass, or slips, when exerted through organized ether, or matter of a certain kind, which we call metals or conductors. According to the cog-sphere theory, the ether-cells in the substance of a copper wire are devoid of cog projections, or have smooth contiguous surfaces, so that the rotation of the cells outside the wire produce slip at or within the surface of the wire. The paper draws attention to the fact that whereas practical electricians are well aware of the generation of electromotive force by the movement of a magnetic field, as in dynamos, they are not so generally aware of the converse proposition of the generation of magnetomotive force by the movement of an electric field. That is to say, if an electrostatic field is moved rapidly through space in any direction not parallel to itself, a magnetic force will be generated in and across the field. This remarkable fact seems to be incontrovertible from a theoretical standpoint; but it has only recently been established experimentally beyond dispute, and the effect is but a feeble one. No use of it has yet been made. The first proposition is of great practical importance, since all our dynamos are based upon it. By attaining a speed of sixty meters per second in a field of 12.5 kilogausses, as in some homopolar machines, the e.m.f. due to the motion will be ¾ volt per centimeter, or nearly 2 volts per inch. But with the strong electrostatic field of 3 kilovolts per millimetre, which is approaching the breaking stress of stationary air, and the same high speed of 60 metres per second, the magnetic intensity produced would only be about 20 microgilberts per centimeter. It is hard to see what use could be found for so extremely feeble a magnetmotive force, when a coil of wire carrying an electric current is relatively so much more powerful. The practical men may, therefore, be forgiven for losing sight, as a rule, of a proposition, which however interesting scientifically, promises so little utility.

Telephone Service and Rates in New York City.

In April, 1904, the Merchants' Association of New York City, with the object of bringing about, if possible, a reduction in the rates of service, took up the question with the New York Telephone Company and appointed special committees to carry on an investigation as to the different branches of the subject. Mr. U. N. Bethell, general manager of the company, placed the records and system of the company at the disposal of these committees for their investigation, either personally or through experts, and after a series of conferences the work of inquiry was taken up upon the understanding that the telephone company would agree to a readjustment of rates upon an agreed equitable basis if it should appear that such an adjustment was warranted by the facts disclosed.

The association has now issued a voluminous report to its members and to the public, giving in great detail information and data as to the scope, nature and results of its investigation. It was found by the examination of the Audit Company of New York that the average percentage of net earnings to investment for the 15 years to December 31, 1903, was 10.89 per cent, and for the 16 years to December 31, 1904, 11.12 per cent; while for the year 1904 the figure reached 14.64 per cent. The period of 16 years was chosen because it witnessed the complete conversion of the plant from an overhead single-wire system to an underground metallic circuit system, and from the magneto call local battery system to the automatic common battery system. In that period also the system had grown from some 12,000 to over 150,000 subscribers' stations. Upon the basis of this showing, which tended to prove that the percentage of net earnings was rising, the committee concluded that the time had arrived when the public should be given the benefit of a further reduction in telephone rates, and it proposed that the reduction should be on such a scale as to bring the present rate of earning to about a 10 per cent basis. The New York Telephone Company acceded to this proposal, and the readjustment of rates to reduce the net revenue to such a basis was at once begun by the company and carried into effect expeditiously. All subscribers were given the benefit of the new rates regardless of their existing contracts at higher rates. As a matter of fact, the report of the Audit Company shows that while the agreement with the Merchants' Association would carry with it reduction in income of not more than $1,075,000, the reductions actually put into effect for 1905 reach a total of $1,525,000.

The report enters into a very interesting discussion as to the methods upon which a fair charge for telephone service may be based and takes up various questions connected with telephonic financing, engineering and economics in general. As to the New York Telephone System and its relatively high charges as compared with other parts of the country, the report states that improvements and changes have succeeded each other at remarkably short intervals, so that during the 16 years covered by the investigation the whole plant had practically been rebuilt three times, involving necessarily a high ratio of capitalization, as well as a concurrently high rate of depreciation. Some of the central exchanges had, in fact, been rebuilt three times within a period of little more than 10 years. Having in view these facts, as well as the constant expansion of the service and the necessity of offering an attractive investment to new capital, it was the opinion of the committee that to allow a fair return on capital actually and necessarily invested, as well as a proper allowance for contingencies, a 10 per cent margin above operating outlays was only a reasonable and proper one in the telephone industry.

In the discussion of reasonable rates, it is pointed out by the committee that the subject is an extremely complex one, and the difficulty is to find factors in different places which are similar, so great are the variations in almost any item which may be selected for comparison. For example: There are differences in the quality, range and quantity of service rendered, and particularly in the methods of charging for the service. There are differences also in the number of subscribers who take different grades of service. In the eighty American cities having a population of over 50,000 the ratio of residence telephones to the total number of telephones varies from 15 per cent to 71 per cent; of party line telephones to total telephones from 4 per cent to 84 per cent; of private branch exchange telephones to total telephones from 1 per cent to 41 per cent; and of extension telephones to total telephones from 4 per cent to 13 per cent.

Another striking difference in conditions peculiar to the telephone business between large and small cities is mentioned. In a small city a single central station suffices for prompt intercommunication between two or three thousand users or individual stations. A single switchboard and single operator completes each connection called for, and the area served being comparatively limited, the wire-mileage is relatively small. In large cities such simple conditions do not, and in the very nature of things, cannot, exist. For example, in the Borough of Manhattan, seventeen central stations are required. Each of these must not only provide for intercommunication between the individual stations directly attached to it (the average number being over 8,000), as in the case of the single central station in a small city, but must also provide for prompt intercommunication with sixteen other central offices and over 140,000 individual stations outside its district. Thus, each central station, besides the equipment required for service within the district, must have sixteen distinct auxiliary cable systems connecting it with sixteen other districts. Every new central station that is added compels every existing central station to install additional connecting central office apparatus and an additional connecting cable system to afford intercommunication between every district of the entire system. This connecting plant, and the labor required to maintain and operate it, are not represented by any corresponding factors in a small city having but a single central station.

The report also entered into the question of the method of readjustment and distribution of rates, and is very strong in its condemnation of the flat rate as a basis. The committee considered that in large cities the flat rate with unlimited service is based upon a fallacy, is extremely unjust to small users, favors large users unduly, impedes expansion, tends to inefficient service and is unsound as a financial proposition. At the same time, it is admitted that in small places the flate rate system might prove fairly equal to all subscribers as the conditions would not permit any very extreme variations in any of the contracts. The measured service basis is approved of by the report, beginning with a relatively high maximum rate for small users and declining to a relatively low minimum rate for large users. A telephone station and its collateral equipment represent a definite capital outlay, as well as a continuous outlay for the maintenance of an operating staff in readiness, irrespective of the number of calls made. The message rate must provide for this fixed charge and if the calls are few must be relatively high. It is pointed out in the report that in a large area, such as New York City, the public interest is best served by the application of various rates to the different localities so as to meet the peculiar requirements of each section The method of treatment followed in Greater New York has been upon this plan, and the general rates for local service in all of the outlying sections are much less than those in the great Borough of Manhattan, rates in some sections being as low as $24 a year for unlimited local service. In addition to the rates for local service an extra or toll rate is charged for connection with other districts so that the extra rate is imposed only upon those who make use of the extra service. The report shows that in May, 1905, with 148,595 telephones in use, the rates for business telephones were $135 for 2,400 messages; $87 for 1,200, and $60 minimum. In 1894 the corresponding rates were $240, $166 and $150. Equivalent and even greater reductions have been made in the rates for residence telephones.

Some sections of the report are devoted to the consideration of the telephone service given in New York City, and various disinterested authorities are cited who describe the service as unequaled in the world for general efficiency and effectiveness. A report in detail is also presented from Westinghouse, Church, Kerr & Co., on the method employed by the New York Telephone Company in recording local calls, and the technical details show that there have been questionable cases of counter registration in six months of about one-tenth of one per cent of all the counters in service, while the cases it was necessary to adjust were less than one-fiftieth of one per cent. In fact, it is said "The probability of error appears to be reduced to a minimum, and such as may occur seem even more likely to count against the Telephone Company, and in favor of the subscriber." In other words, the automatic recording system designed by the Western Electric Company substituted for the older ticket system is approved by the commit-

tee and its experts as being a great advance in that it lessens the demands upon operators, permits them to give uninterrupted attention to the answering of calls and dispenses with much clerical assistance.

One section of the report deals with the question of regulating rates by competition and upon the results of competitive service in any given community. The views of the committee would seem to be that rival systems involve an economic waste and the general conclusions may be quoted as follows: "It is obvious that two systems involve extensive duplication of plant and organization, which entails a heavy additional burden of fixed charges and operating expenses, much of which would be unnecessary if the service were performed by a single system. This duplicated outlay, being in excess of the amount really necessary to perform the service, is an economic waste. In telephone operation no compensatory benefits to users in the form of lesser cost of service or increased efficiency have yet developed to justify this waste. The dangers coming from it are easily seen. Unless it is provided for in the charges exacted from consumers, the capital investment will be gradually eaten up. In the meantime, as abundant experience in railroad competition has shown, equipment will be permitted to deteriorate, operating expenses will be reduced below the proper limit, and the efficiency of service will be lowered.

"In the opinion of this committee, competition in telephone service is not a public benefit, and not a useful means of regulating charges. As shown above, little or no benefit accrues to any part of the public in the way of reduced rates, many consumers are compelled to increase their aggregate outlay, the utility of the service is cut in half, expansion made difficult, the efficiency of the service threatened and the capital investment endangered. Competition in telephone service does not offer a choice of benefits, but compels a choice of evils—either a half-service or a double price."

Consolidation of American Street Car Builders.

Long talked about, a consolidation of American builders of trolley cars has at last been effected, according to announcement made by Kean, Van Cortland & Co., of New York, who are to finance the new organization. Nineteen companies will be taken over and capitalized under a new company at $43,000,000. The name of the new company has not been decided, but Mr. G. Martin Brill, of the J. G. Brill Co., of Philadelphia, will be president. It would seem that responsibility for the promotion of the scheme lies mainly with W. T. Van Brunt, president of the St. Joseph & Grand Island Railway, president of the Furnaceville Iron Company and associate of E. H. Harriman. The companies to be taken over are: J. G. Brill Co., John Stephenson Co., Laclede Car Company, St. Louis Malleable Casting Company, American Car Company, G. C. Kuhlman Co., Cincinnati Car Company, St. Louis Car Company, Wason Manufacturing Company, Osgood, Bradley & Sons, John J. Cummings Car Company, Jewett Car Company, J. M. Jones' Sons, agents; Laconia Car Company, McGuire-Cummings Manufacturing Company, Peckham Manufacturing Company, Niles Car Manufacturing Company, Journal Bearing Company, Easy Access Door Company.

The circular issued by Kean, Van Cortland & Co. descriptive of the plan, does not state the terms at which the companies are to be taken over. The capital of $43,000,000 will consist of $15,500,000 6 per cent cumulative preferred stock, and $27,500,000 common stock. A $13,000,000 issue of first mortgage and collateral trust sinking fund 5 per cent, thirty-year bonds is proposed; $11,000,000 to be issued upon the formation of the company, and $2,000,000 to be reserved for future requirements.

The annual average of net earnings of the constituent companies is put at $1,263,391, and the estimated earnings of the first year of the consolidated company will amount to $2,400,000, the promoters say. The company will be organized and the properties transferred to it under the supervision of the attorneys, Davis, Stone & Auerbach and Guthrie, Cravath & Henderson. It is estimated that the consolidated company will acquire quick assets of $6,400,000, consisting of cash, raw materials, cars and accounts receivable, also many valuable patents and patent rights, by the control of which considerable patent litigation will be avoided. Great economies are expected for concentration of plants and manufacturing at strategic points for delivery.

Electricity at the Liege Mining Congress.

At the Paris Exposition in 1900 there were shown only two or three small electric furnaces with a few samples of all the metals or alloys produced by electricity. At the recent Liege Exposition and Mining Congress, however, there were displayed large steel ingots, blocks of ferro-silicon, chrome iron and other alloys, obtained electrically. A paper by Robert Pitaral, of Paris, pointed out that the great advantage of the electric furnace resides in the high temperature which it affords—namely, 2,000 to 3,000 degrees C. Hitherto the electric process has been possible only for making steels of high quality. It is economical for pig irons when the electric power is cheap and fuel is very dear. It is apparent, however, that in any case the electric furnace will be employed hereafter at the end of the usual refining operations. Gustave Gin, of Paris, stated that the electric furnace is capable of giving all of the series of steels, and will probably serve for making high-class metals. In the making of steel, the electric process has the following advantages over the open-hearth process: A much greater concentration of the heat, permitting the utilization of far smaller spaces; a more methodical and more controllable working, and the avoidance of contact between the metal and the gases, which are often not entirely reducing.

For driving roll trains L. Creplet, engineer of the Société International d'Electricité, Liege, advocated the use of continuous-current motors. There are already several applications in Belgium. The Grievegnée Company uses a merchant mill driven by a compound-wound motor that can develop from 450 to 900 horse-power, and the Providence Company has another capable of from 500 to 1,000 horse-power. The Ougrée-Marihaye Company (which has already applied this improvement) will in a few months have in use a roll-train motor of 1,000 to 1,500 horse-power, capable of direct driving at 75 to 135 revolutions per minute. M. Greiner, general manager of the Cockerill Works, Belgium, stated that the problem of driving roll trains electrically is already solved from an economical point of view, and he expressed the opinion that the best solution is central electric generators driven by gas engines, and each roll train driven by its own motor.

Consolidation of Pole Lines at Los Angeles.

The electrical companies operating in Los Angeles have entered into an agreement to consolidate and combine their pole lines, with the result of abolishing more than half of the poles now in use in that city. The parties concerned are the Pacific Light & Power Company, the Edison Electric Company, the Los Angeles Gas & Electric Company, the Los Angeles-Pacific Railway, the Pacific Electric Railway, the Los Angeles Railway & Interurban Railway, the Sunset Telephone Company, and the Home Telephone Company. The completed plans have been more than a year in the making by Mr. E. A. Beck, superintendent of the Pacific Light & Power Company, who has devised a form of agreement to which all could conform.

The system finally decided upon is absolutely unique in corporate history. A clearing-house is to be established for the consolidated companies and an extensive system of regulations and business by-laws has been drawn up, to which all of the companies must conform and enter into contract for, just as they would to formal articles of incorporation. The clearing-house will be maintained in a separate office, and will be ruled over by a committee, made up of the managers of the different companies, who will meet once a week for the transaction of business. The committee will have a secretary, or secretaries, as they find one or more necessary, who will work solely upon inter-corporation business, and to whom all orders, pole reports and plans for change will be referred. There will be three main agreements, the final details of which are yet to be completed. The first will be between the lighting companies and the street railways, the second between the two telephone companies, and the final btween the parties of the first, and the parties of the second part.

The telephone companies will go by themselves, and telephone wires will be upon telephone poles alone. While light, power and railway cables will be upon one side of the highway, the telephone systems will rise upon the other, in combination, and thus the trolley wires will find their usual suspension.

One of the articles of agreement is this: In combination of the old lines, the companies will use the system having the highest poles. This settles definitely one point—as to whose poles should come down,

and whose poles should stay up. All poles in the combination are to be neatly planed, uniformly painted and stepped according to the standard method.

Each party to the pact will maintain his own corporate system of wires, but by a clause in Beck's constitution and by-laws, the company on top—a coveted position—is to maintain the pole. A uniform price has been fixed, and will probably stand at 35 cents per foot, which all parties coming into the combination are to pay, and thus general expenses are to be shared.

In the matter of transmission lines, other than the regular lines, the agreement also contains a clause: Each party owning a transmission line on top of the pole—the usual place for it—must own two shares of the pole's value. Thus, if a railroad and a lighting company are on the same pole, and the railroad has a feeder running along on top, the railway must own two-thirds of the pole's value But if another electric company comes into the combination, the railroad will only have to own half the pole's value—still two shares of it.

Preservation of Electrical Poles.

Attention has already been called to the work of the U. S. Bureau of Forestry, in co-operation with the American Telephone and Telegraph Company and the Postal Telegraph Cable Company, to find the best methods of seasoning telephone poles and of treating them with preservatives. Fifty green poles were furnished every month to each of five experimental stations. Each pole was exposed to the open air and was weighed every month until it ceased to lose. The rate at which weight was lost showed the rate of seasoning in different months.

After one year of seasoning preservative treatment was applied to the poles, beginning last spring. Most of those at two of the stations—Wilmington and Pisgah, N. C.—were treated by applying the preservative with a brush. In a few cases a cap or plate was fitted to the butt of the pole and creosote forced in by a pump, but with unsatisfactory results.

To test the efficacy of the treatment as a preventive against decay the poles, carefully numbered and labeled for identification, have been set in an experimental section of the American Telephone and Telegraph Company, between Savannah and Meldrim, Ga. Each treated pole is set between a green and a seasoned pole, so that the absolute and relative values of the different preservatives will be fully tested.

At Dover, N. J., in addition to the external applications, a number of seasoned poles were treated in an open tank, constructed to take thirty-foot poles inclined at an angle of 20 degrees. In this tank they are boiled in creosote for several hours. They are then either shifted to a tank of similar construction containing cold creosote, in which they stand for several hours, or are left in the hot oil to cool down gradually.

A College of Municipal Ownership.

According to advices from that city, Chicago is to have a new educational organization devoted to the subject of municipal ownership. The plans have been perfected during the last few days and, according to the recent information, the courses will be opened to the public next autumn. The undertaking will start with an ample endowment supplied by several citizens, who are known collectively to the public as the "Dunne Machine." The work of the "Municipal Ownership University" is to be modelled after the extension lecture course in the department of the University of Chicago. The endowment will be devoted to the organization and support of a lyceum as a medium for explaining the problems of municipal ownership to the people, free of charge.

A municipal ownership extension centre will be established in each of the thirty-five wards, and subsidiary centres in as many voting precincts as the demand warrants. The lecturers will appear at these centres in rotation during the next year and a half—until the next city election. A part of the plan is to explain to the people that municipal ownership may be attained by re-electing Mayor Dunne indefinitely until success shall crown his efforts.

Mayor Dunne has selected for the head of his institution City Prosecutor Howard O. Taylor, who formerly was a clergyman and is customarily addressed as Dr. Taylor. The Mayor delegated the organization of the enterprise to Dr. Taylor some weeks ago, and it is understood that the plans are practically completed.

Judge Murray F. Tuly is to be chancellor emeritus and will conduct seminars in municipal ownership theory for more advanced students. Mayor Dunne, it is understood, will lecture frequently. This all sounds like a joke, but is given out as serious news.

A Sketch of Multiple Unit Railway Development.

In the second and concluding section of his interesting narrative of electric railway development, in the *Century Magazine* for August Mr. Frank J. Sprague gives the following historical sketch of the introduction of the multiple unit system:

Pondering over the elevated railway train problem one day, the thought suddenly flashed upon me, Why not apply the same principle to train operation? That is, make a train unit by the combination of a number of individual cars, each complete in all respects, and provide for operating them all simultaneously from any master switch on any car. This idea, sketched on a scrap of paper, marked the complete birth of this new method, then named and now nearly everywhere known as the "multiple unit system." Its great possibilities instantly absorbed my interest, as I saw the opening of a new epoch in electric railway operation. Here was a way to give a train of any length all the characteristics of a single car, with every facility of operation which could be demanded by the most exacting conditions of service and capacity.

After two abortive attempts to get the privilege to demonstrate the advantages of the system at my own expense on the Manhattan road in New York, an unexpected opportunity suddenly arose in the spring of 1897, when I was requested to act as the consulting engineer of the South Side Elevated Railroad of Chicago. A brief inspection of the layout showed a field ripe for multiple unit application, which I briefly explained to Sargent and Lundy, the engineers, and to Mr. Clark, of the General Electric Company, fortunately all old friends. I hastily drew up a report, the main feature of which was an argument in favor of the abandonment of locomotive cars, and the adoption of individual equipment under common control—in short, the multiple unit system. As an earnest of my confidence, I supplemented the report by an offer to undertake the equipment of the general plan outlined, which met with the indorsement of the engineers. This was followed by a visit to Chicago; but the contract was not concluded until after I left for Europe, and then only after a very bitter fight with various companies, and under most onerous conditions, supplemented by a $100,000 bond for performance.

Among other things, I was immediately to begin work on the entire equipment, and to have six cars ready for operation in two months, on a standard track supplied by me, the manner of making the test to be prescribed by the officers and engineers of the road, and to be to their satisfaction. Should the test be not concluded by the date set, or be unsatisfactory, the contract should be cancelled. Satisfactory further tests should be called for elsewhere, and the remaining equipments were to be completed by specified dates. As soon as the power house and road were ready there was to be another test of not less than twenty equipments under service conditions for a period of not less than ten days. Should these equipments prove unsatisfactory, the right remained to cancel the contract and to require waiver of all claims against the company.

I did not return to New York until about the middle of June, so that most of my instructions for the trial equipments were by cable, and the actual preparation was made within thirty days, despite a wholesale strike of the machinists employed in the shops of the new Sprague Electric Company, which soon took over the contract.

On July 16, 1897, two cars were put into operation on the tracks of the General Electric Company, at Schenectady, and on the 26th, the half-century anniversary of Prof. Farmer's test of a model electric railway at Dover, N. H., my ten-year-old son operated a six-car train in the presence of the officers and engineers of the South Side Elevated Road at Schenectady.

In November a test train of five cars was put in operation in Chicago, and on the 20th of April following twenty cars, seventeen

of which (one in flames) were taken off during the day because of defective rheostats; but with the last three-car train I had the satisfaction of pushing a steam train around a curve. Three months later, a year after the Schenectady test, locomotives had been entirely abandoned, and the whole 120 cars were in operation, the local work being largely supervised by my assistant, Frank H. Shepard.

The system, with sundry changes in detail, has now been universally adopted for electric train operation on underground, elevated and suburban roads, and the largest present enterprise in substitution of steam operation, the electrification of the New York Central terminals and a portion of its main line, is likewise dependent upon it. There not only the suburban cars, but the great locomotives supplied by the General Electric Company, of 2,200 hp capacity, and weighing 100 tons, are to be controlled on the multiple-unit plan, so that two or even three locomotives, representing an aggregate of several thousand horse-power, under simultaneous control, can be put at the head of any train which may be made up.

Cables and the Island of Yap.

An interesting communication from Washington as to the cable system in the Pacific appears in the New York *Evening Post*. It makes the following remarks as to the island of Yap.

For the meeting place of railroad lines to become an important town, as a creation of their own map-making, has long been common. Similarly the ocean cables in this age are assuming an importance that permits them to give world prominence to any distant island of the sea which lends itself to their uses as a junction point. To-day little Yap, east of the Caroline Islands, but not of them, and about nine degrees north of the equator, has become the most interesting point on the face of the globe in this respect. Three great cable companies have already put wires into Yap, and a fourth one is in contemplation. There they will exchange their messages—transship them, so to speak. Its harbor will be developed into a considerable port of call, since information is a commodity in the modern world influencing the course of navigation almost as much as any article which contributes to the cargo. The completion of our trans-Pacific cable, via Honolulu and Guam, radically affected the ocean lanes of the Pacific. So the developments now in progress at Yap promise to make it a famous town of the future, although its present reputation is chiefly associated with the strange performances of one O'Keefe, one-time "king."

Yap has cable communication with the Island of Jaluit in the Marshall group, connecting it with a great and rapidly growing German system. It has been connected with the American cable line at Guam, which is not far away. It has also been connected with the Dutch East India Company at Meando, which is at the northern extremity of the island of Celebes. It will soon be connected with the British cables at Shanghai. The ship that touches at Yap can thus secure direct communication through the great cable systems with every port in the world.

The development at this German island is of considerable significance in world politics. The Germans will thus flank our connections with the dependencies of the East, paralleling our route to the Philippines by way of Honolulu and Guam, for over a thousand miles, by a cable connecting a chain of islands under the German flag.

Electric Motor Service in Scotland.

In his recent presidential address before the Incorporated Municipal Electrical Association, Mr. F. A. Newington, chief electrical engineer, of Edinburgh, Scotland, said:

"One of the aims of a municipal electrical undertaking is to utilize the machinery during the day time as much as possible, and therefore electricity for power or heating purposes is sold at a low rate. But there is a weak point in this arrangement. The motors are using during the time of maximum lighting load during the winter months and, therefore, additional machinery must be provided for them. If we can arrange for the motors to be switched off during the two or three hours of maximum load for lighting in the four winter months, extra machinery will not be required, so a very low rate can be charged. This system is just now being adopted in Edinburgh, and is also in force in a few other cities.

"On analyzing the consumption of electricity by motors, it is generally found that the load factor is extremely low. The following figures show the average number of hours a day during which the total power installed is used for different classes of work in Edinburgh:

Purpose.	Total hp. installed.	Full load, hours per day
Elevators	610	.9
Butchers and bakers	180	1.27
Printing works	1327	1.52
Breweries	247	1.13
Joiners and builders	1057	1.85
Engineering works	981	2.08
Laundries	40	2.87
Aerated water works and bottling stores	28	3.27

"Unfortunately, these figures refer to kilowatts installed, not to maximum kilowatts required, but they show that the whole plant would only be used for an exceedingly short time each day. From these figures it is quite certain that the total power used at any one time is not half the power installed, and so the hours per day can at least be doubled, but even then the load factor would not be good. As the cost of generating electricity will be in inverse proportion to the load factor of the motors, this should be considered when fixing the price of electricity for power purposes."

Programme for Municipal Electricans' Convention.

The annual convention of the International Association of Municipal Electricians is to be held at the Reed House, Erie, Pa., August 23, 24 and 25. Secretary F. P. Foster, of Corning, N. Y., sends us the following programme: "The Effects of Electrostatic Influence in Telephone and Telegraph Circuits," H. R. Allensworth, Columbus, Ohio; "The Advisability of Fusing Fire and Police Telegraph Boxes," C. E. Diehl, Harrisburg, Pa.; "Electric Light Engineering," A. S. Hatch, Detroit, Mich.; "Erection and Maintenance of Electric Lighting Plants," C. L. Williams, Meridian, Miss.; "Suggested Improvements in Fire Alarm Telegraph Systems," Capt. Wm. Brophy, Boston, Mass.; "The Necessity of a Rigid Inspection by the Municipality," T. C. O'Hearn, Cambridge, Mass.; "Underground Construction," Louis Gascoigne, Detroit, Mich.

CURRENT NEWS AND NOTES.

ILLINOIS STATE ELECTRIC ASSOCIATION.—Mr. D. Davis, Litchfield, Ill., secretary of the Illinois State Electric Association, states that the next annual meeting of that association will be at Peoria, October 5 and 6.

TELEPHONE UNDER WATER.—Under the provisions of a bill passed by congress for the establishment of a system of submarine signals along the Atlantic Coast for the prevention of shipwrecks and for signaling to naval vessels, the sub-marine telephone is being tested at the Boston navy yard.

CANADIAN MUNICIPALITIES.—The fifth annual convention of the Union of Canadian Municipalities is being held during the current week at Winnipeg, Man. A number of papers are listed dealing with municipal topics, one or two of them discussing municipal ownership, and one the work of the parliamentary telephone committee.

FRENCH CABLE IN VENEZUELA.—A cable from Caracas to the New York *Herald* says that the Venezuelan authorities have instituted proceedings against the Compagnie Francaise des Cables Telegraphiques (the French Cable Company), for damages incurred by the government through the cable company's alleged participation in the Matos revolution.

A STREET CAR FARE TAX.—Mr. A. Sato, a member of the Japanese peace embassy, in an interview on his arrival in New York, said that the war taxes had not oppressed the people. "One of the taxes is on street car fares. The ordinary fare is 1½ cents, and on every ticket sold there is a ½-cent tax, collected by means of a special coupon attached to the ticket. A curious thing is that if you buy one ticket you have to pay the full ½-cent tax, but if you buy 100 tickets at once, the tax is only 5 cents."

DEVELOPMENT OF PERU.—The city of Iquitos, Peru, is to have an electric lighting plant, and a wireless telegraph station communicating with Puerto Bermudez. The city of Asuncion, capital of Paraguay, is also to have an electric light plant.

WATER POWER IN SPAIN.—The Sociedad Electroquimica de Flix (Tarragona Province) has received the concession to take power from the River Ebro at the rate of 80 cubic meters of water per second. The installation must be commenced within five months.

TELEPHONES TO TEACH DEAF MUTES.—The Board of Education of Cleveland, Ohio, will install telephones in the Willson Avenue School for the Deaf to instruct children who are able to distinguish sound in a slight degree. The plan was suggested by its success in an institution for the deaf at Rochester, N. Y.

BRYAN ON TELEPHONES.—At Lima, O., a week ago, in an interview, Mr. William Jennings Bryan declared for the municipal ownership of telephones and said: "A city should have but one telephone system. More than one works an unnecessary hardship upon the business and professional people. One system of rural telephone service is sufficient, and that should be owned by the county, and the city should own its system."

ELECTRIC FANS.—U. S. Consul-General Wright, of Munich, Bavaria, mentions electric fans as one of the American specialties that could be introduced and pushed to advantage in Switzerland, Southern Bavaria and the Tyrol, where, as he says, the increasing number of tourists, particularly Americans, has made it necessary to have more of the modern improved appliances for comfort. Almost all of the resorts have electric current available from water power.

THE MANILA TROLLEYS.—From correspondence in the London *Chronicle* we take the following: "We were fortunate enough to land in Manila on the very day when the new electric trams were opened. There are 50 miles of rails, all installed on the latest Yankee plan. The streets were crowded with Filipinos, Spanish, Chinese, etc., staring in wonder at the novel sight. 'No pushee, no pullee, go like hellee!'" Could Kipling himself put it more graphically than does that touch of pidgin English?"

N. E. L. A. PUBLICATIONS.—There has been a brisk demand for the excellent Question Box and Wrinkles publications of the National Electric Light Association this year, from members who do not wish to wait for the final bound volume of transactions. Mr. W. C. L. Eglin, the secretary, announces that it has been decided to meet this call for extra copies by furnishing them in paper, at a cost of $1.25 for the two books. Orders should be sent to the Association office, at 136 Liberty Street, New York City.

THE MURGAS WIRELESS SYSTEM which was described recently in these pages, was tested satisfactorily last week between Wilkesbarre and Scranton, Pa. The tests were conducted by Father Murgas, Joseph F. Stokes and Ferdinand Muckley, of Philadelphia, who are backing him, by Mr. E. W. Stevenson, the electrical expert, and some expert telegraphers. The test was between the station in Wilkesbarre and the one in Scranton, and the first message sent over the wire was "Thank God for His blessings." Other messages were sent. Father Murgas receives a lump sum for his patent and also gets royalties.

SUBMARINE BELL SIGNALS.—It is stated from Canada that the River St. Lawrence is not to have the benefit of the submarine bell signals which were contracted for some months ago by the Dominion Government. At a recent meeting of the Shipping Federation of Canada the matter was gone into and the decision was arrived at that the seagoing shipping of the St. Lawrence would not adopt them. It was contended by members of the Shipping Federation that while there was no question of the system being an aid to navigation in the St. Lawrence between Montreal and the sea, the expense incurred by steamboats, by the establishment of the system on board each vessel, was such that they could not afford to take it up. It appears the owners of the submarine signal company, of Boston, proposed to charge each steamship $500 for special equipment of t' coast line down through the gulf.

A TWO-BLOCK TROLLEY LINE.—The Williams Terminal Railway Company, of Brooklyn, has been incorporated at Albany with a capital of $10,000 to operate an electric surface line from the tracks of the New York Dock Company on Bowne Street to the property of J. H. Williams & Co., in Richard Street, Brooklyn. The railroad is to be used for transferring freight. It is to extend for two blocks and connect with the freight shifting road of the New York Dock Company, which runs along the water front. It will handle forgings.

THE EDISON BATTERY.—In an interview in Philadelphia last week, Mr. Edison made some interesting statements about his recent storage-battery work: "By October my light battery will be ready for the market and we shall be ready to equip automobiles of all descriptions," he said. "To reach a definite conclusion of its possibilities I manufactured 14,000 cells, and equipped about 160 conveyances of all descriptions. In Washington we attached the batteries to a number of express delivery wagons, with the result that after many months the cost of operation has been found to be 58 per cent of that of horses. The batteries manufactured varied in types, so that I might obtain the happy average I wished to strike, and I am prepared to make the unqualified statement that the Edison battery will revolutionize the storage-battery problem. It will weigh just one-half of the present battery in general use, and will be about the same size, although it stands somewhat higher in its proportion than the other. As to its power, there can be no question. I had a big two-ton car brought to my factory in Orange, where it was fitted with cells, and we took it out and sent it over the roads of New Jersey at 33 miles an hour. The new factory, where the new cell batteries are to be manufactured is being erected in Orange, and automobiles will be built and equipped there."

ALUMINUM PAPER.—U. S. Consul-General Guenther, of Frankfort, Germany, writes: "Aluminum paper is now manufactured in Germany and recommended as a substitute for tin foil. It is not the so-called leaf aluminum, but real paper coated with powdered aluminum, and is said to possess very favorable qualities for preserving articles of food, for which it is used as a covering. Chemical analysis has proven that aluminum paper contains but few foreign substances; occasionally it may contain up to 2 per cent of iron, but never any arsenic or other poisonous metals. Hence it appears that the powdered aluminum used for the manufacture of aluminum paper is relatively pure. The paper used is a sort of artificial parchment, obtained through the action of sulphuric acid upon ordinary paper. The sheets are spread out and covered upon one side with a thin coating of a solution of resin in alcohol or ether. Evaporation is precipitated through a current of air and the paper is then warmed until the resin has again become soft. Then powdered aluminum is sprinkled upon it and the paper subjected to strong pressure to fasten the powder thereon. The metallic covering so obtained is neither affected by the air nor by fatty substances. Aluminum paper is much cheaper than tin foil and will, so it is thought, become a strong competitor thereof."

HARTFORD-WORCESTER TROLLEY.—It is stated from Boston that plans for the construction of the Hartford & Worcester Street Railway, which will form a long trolley line between the two cities, have been completed by the Shaw interests of Boston, which control and operate the Boston & Worcester Street Railway. The moving spirit in the enterprise is James F. Shaw, who carried into effect the plans for the Boston & Worcester line. The Hartford & Worcester will practically be a continuation of the Boston & Worcester line. The principal reason for building the road is that it will furnish the Boston & Worcester with a feeding tributary, and a direct branch road will be run into Springfield, Mass. The completion of these continuations will place Boston and Worcester in direct competition with the New York, New Haven & Hartford interests, the latter having bought up the Springfield street railways. An agreement exists between the Boston & Worcester and Worcester Consolidated Street Railway Companies whereby the cars of the former and the Hartford & Worcester will be taken over the tracks of the Consolidated, the managers of the latter company taking the cars at Lake Quinsigamond and running them out of the city to Spencer, where the Hartford cars will enter upon a private right of way. Most of the route is over private right of way, as in the case of the Boston & Worcester.

CHEAP RADIUM.—A cable dispatch from Berlin of July 27 heralds cheap radium, or a substitute, once more, as follows: "The German scientific world is much interested in a discovery made by Herr Erfeurt, a chemist, who has succeeded in transmitting the qualities of radium to a substance he calls radiopher. Radiopher can be made cheaply. It is of great use in medical practice, for it can be injected under the skin and in other parts of the body. It is said to possess all the qualities of the original radium." As is well known, Dr. W. J. Morton and others in this country have already done some pretty good work in the production of radioactive liquids, which has been duly recorded in these pages.

WIRELESS ONE THOUSAND MILES.—Lieut. Kaiser, who had charge of the wireless apparatus on board the cruiser Brooklyn, flagship of Rear Admiral Sigsbee's squadron on the trip to France and return, has made a report to the Bureau of Equipment on the tests made during the voyage to determine at what distances wireless messages may be received aboard ship from shore stations. He reported that the longest distance at which wireless messages were read during the daytime was 540 sea miles, and at night 1,100 sea miles, while a wireless signal was heard at a distance of 1,780 sea miles. The message received at a distance of 1,100 miles, he said, came in so strong that doubtless it could have been taken effectively at a still greater distance.

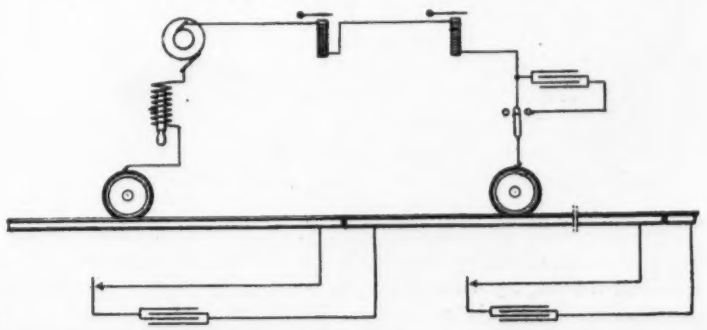
"SPOT LIGHTS."—An actress named Margaret Esmonde is plaintiff in a suit for $10,000 based on the fact that a defective spot light employed to enhance the piece de resistance of her part impaired her eyesight to the tune of $10,000 worth. The case in question concerned a death scene, wherein Miss Esmonde, prone upon the floor, was compelled to portray a death stare, and the continual glare of a spot light on her eyes has resulted in damage to her optic nerves. Miss Esmonde claims to have been favored with other spot lights in other theatrical performances without serious results, but in this case her deductions portend a defect in the electrical appliance, which acted upon her eyes so seriously that she is now compelled to seek redress. It will be interesting to see how this curious case results.

SPEED REGULATION OF REPULSION MOTORS.—An analysis of the internal reactions of the magnetic fluxes of a repulsion motor reveals the fact that to obtain the best performance from the machine the brushes should be placed in a certain position on the commutator when the rotor is at rest, and that they should occupy a different position under speed conditions. An invention of G. H. Hill, which was disclosed in a patent issued July 25, has for its object to provide means for automatically shifting the brushes of the motor according to the speed of the rotor. The brushes are mounted on a rotatable holder which is connected mechanically with the moving member of an electro-dynamometer the torque of which depends upon the current taken by the motor. The torque at which the dynamometer will be effective in moving the brushes is adjustable by means of a counter weight. With decrease of current and consequent decrease of torque the weight causes the brushes to be shifted in a direction to allow the motor to take more current through its circuits. The device produces a constant current flow through the motor, and gives an acceleration corresponding to a constant current.

ENGLISH RAILROAD ACCIDENT.—A cable dispatch from Liverpool, of July 27, says: "An electric express train on the Lancashire & Yorkshire Railroad, bound from Liverpool for Southport, came into collision this evening with an empty stationary train at the Hall Road Station, 6½ miles from this city, causing the death of 23 persons and the injury of many others. The first car of the express, which was crowded, was smashed to pieces, and only six of the occupants escaped. The road was recently equipped with electric power. This is the first serious accident on an electric railway in England. The collision lifted the roof of the first car of the express completely off the steel frame and crashed it down again on the unfortunate passengers, 20 of whom were killed outright. More of them would have been killed but for the presence of mind of a Liverpool architect, who, seeing that a collison was inevitable, shouted to his fellow-passengers to throw themselves upon the floor of the car. Almost immediately after the crash the wreckage burst into flames. The victims included several women and children. Fortunately the badly injured number comparatively few." This road is very successful and has already developed a large traffic. The expresses run about 60 miles an hour.

ELECTRICAL FIRES.—The Electrical Bureau of the National Board of Fire Underwriters in its report No. 48 gives a summary of the record of electrical fires which have been brought to its attention between April 10, 1905, and July 10, 1905. Twelve fires were caused by the grounding of circuits, of which four were on gas pipes, the resulting arcs burning holes through the pipes and igniting the escaping gas. Twelve cases are recorded of fires caused by short circuits in service wires. Seven crosses of high and low-potential circuits have been reported. Seven fires were caused by uncovered fuses throwing molten metal into inflammable material. Six fires are attributed to electric heaters and flat-irons. Seven fires were due to lightning. Five pole and tree fires were reported. Reports of 35 other fires attributed mainly to defective electrical fittings have been received, making a total of 91 known to have been due to electricity during the last quarter. The losses aggregate over $593,800. These reports have been compiled so as to demonstrate, by actual illustration, specific dangers that lie in a lax enforcement of the National Electrical Code of Rules, and to bring about a greater unanimity of opinion regarding the problems presented by electricity considered as a fire hazard.

ELECTRIC SIGNAL SYSTEM.—A novel use for a condenser is disclosed in a patent issued July 25 to W. S. Franklin and W. R. Whitehorne for a system designed to indicate in the operator's cab of a train the condition or position of successive signals along the line of the track. Each semaphore is provided with a switch so supported that it will be closed whenever the arm is in its inclined, or safe, position, and open when the arm is in its horizontal, or danger, position. One terminal of this switch is connected to one rail-section and the other terminal is joined to one terminal of a condenser whose second terminal is connected to the adjacent rail section. The circuits are indicated in the accompanying diagram. Upon each locomotive, or operator's, cab there is placed a small alternating-current generator, one terminal of which is connected to one of the wheels of the locomotive, which is electrically insulated from the other wheels. The second terminal of the generator is grounded on the frame of the locomotive through certain magnet windings. Except when the locomotive is immediately over the insulated break in the track, the amount of current which the generator is able to force through the impedance in the local circuit is too small to be effective in operating the signal governed by the electromagnets on the locomotive. When the locomotive spans the insulated break in the track, the current in the local circuit either drops to zero value, if the semaphore switch (referred to above) is open, or increases, perhaps, ten fold if the semaphore switch is closed. The abnormal increase in current at the instant when the locomotive passes into a section where the semaphore arm is in the "danger" position, is due to the introduction of the condenser in series with the inductive impedance, the condensive reactance and the inductive reactance having been so chosen as to neutralize each other at the frequency of the current obtained from the generator, which current, therefore, increases to a value limited only by the resistance of the local circuit. The action of the increased value of the local current is to cause an electro magnet to release a spring which sets a "clear" signal in the cab of the locomotive. When, however, the current in the local circuit drops to zero value, the decreased strength of a separate electromagnet allows a "danger" signal to be set in the cab.



ELECTRICAL POWER IN ONTARIO.—It is stated that the Electrical Power Commission, recently created by the Ontario Government, proposes to divide the province into four electrical districts, the idea being to select a water power in each district where electrical power may be generated and transmitted to all other points in the district. The four great water powers destined to supply the respective districts are Niagara Falls, the Chaudiere Falls at Ottawa, St. Mary's Rapids at the Soo, and Kababeka Falls, near Fort William. It is estimated that power from these centers can be transmitted for 200 miles and still be more economical than steam power. The commission proposes to secure the fullest information with regard to the cost of development, cost of transmission and price that would have to be charged consumers in order that a proper return may be made on the money invested. It is said that the Government does not propose to go in for power development itself except as a last resort, but will endeavor to govern and restrict the operations of private corporations, particularly in the matter of rates.

DALRYMPLE ON MUNICIPALISM.—A special dispatch from Chicago as to the Dalrymple report has the following: "There can be no great reform in the affairs of American municipalities until the political boss and the labor union cease to be dictators. They are the greatest curse the United States has to contend with." This is the keynote of James Dalrymple's famous letter in which he reported to Mayor Dunne his suggestions on the municipalization of Chicago's street railways. The much-discussed epistle of the Scotch traction expert to the Mayor of Chicago has never been made public. The impression was that he had backed down on his stand for municipal ownership. Instead, he stands by his guns. No such reform as the proposed municipal traction system can be successfully brought about where American labor union principles find support, he declares, adding that the same is true of American political methods. "I have the highest regard for the Mayor of Chicago," Mr. Dalrymple writes, in substance. "Yet that does not alter the fact that the theory of American politics is opposed to public ownership. Until the system is changed American cities can never hope for successful municipal ownership and operation of public utilities. This is as true of Cleveland as of Chicago—of New York and Philadelphia as of Cleveland."

Electrical Engineers of the Times.—XXI.

MR. F. V. HENSHAW.

Frederick Valdemar Henshaw was born in Brooklyn, N. Y., in 1868, the son of the late George H. Henshaw, a prominent civil engineer of Montreal. His early education was obtained at the High School and at Bishop's College, Montreal, where he devoted some time to the special study of chemistry and engineering.

His first employment was on a survey of a part of the St. Lawrence River during the summer and fall of 1886. He had early been desirous of taking up electrical work and in the spring of 1887 entered the employ of the Royal Electric Company, of Montreal, and was successively apprentice, draftsman and assistant to the chief engineer. While in the employ of this company, which besides manufacturing the Thomson-Houston apparatus, did a great deal of original work, Mr. Henshaw was engaged in the design and construction of probably what was the first alternating-current dynamo build in Canada.

In 1889 he came to New York and accepted a position with the C. & C. Electric Motor Co., where he later became assistant engineer, and remained until August, 1895. During that period this company rose from a small concern making motors not larger than 1 horse-power to be one of the largest manufacturers of stationary motors and generators in the country. Mr. Henshaw's work consisted chiefly in designing and testing machines and apparatus. It may be mentioned that he was one of the first to design direct-connected motors for very large ventilating fans and blowers.

During the next two years Mr. Henshaw was a member of the firm of Downes & Henshaw, of Providence, R. I., which acted as consulting engineers for the Narragansett Electric Light Co., Armington & Sims Engine Company and other large Rhode Island interests. Among other notable work done in that capacity was a series of exhaustive efficiency tests of commercial lighting transformers. The firm also constructed and remodeled a number of lighting and power plants in Rhode Island, and designed a line of generators for direct connection to high-speed engines.

In the fall of 1897 Mr. Henshaw entered the service of the Crocker-Wheeler Company as engineer and designer, becoming, later, chief draftsman and finally assistant engineer, with executive management of the engineering and installation departments. He designed many improvements in the construction of direct-current motors, generators and controlling apparatus; elevator motors having very low starting current; improved magnetic brakes for cranes and improvements in factory plant. He assisted largely in the design and commercial introduction of the multiple voltage system of motor speed control. He proposed this system to the Bethlehem Iron Company for their machine shops about the time that "high-speed" tool steel was being developed, and engaged in tests at Bethlehem which demonstrated at an early date that the power supply for, and the design of, machine tools would need revision to keep up with the capability of the new tool steels. Mr. Henshaw was a pioneer in the serious commercial application of electrical power to industrial plants and did much towards standardizing methods of machine tool drive and in establishing a better understanding between the designers of such tools and the makers of electrical machinery. He gave much study to power requirements of steel

MR. F. V. HENSHAW.

works and had a large part in building up the remarkable electric power plants of the National Tube Co. The successful use of electric power for almost all operations in these mills was due to a constant study of the unique conditions and the devising of new forms of construction to meet them, resulting finally in the development of entirely new types of motors particularly adapted to this large field of usefulness.

Mr. Henshaw also had charge of manufacturing costs and estimates on standard and special machinery and construction work, correcting and determining these figures for the use of the sales department. He wrote and suggested much of the technical matter published by the company and handled the bulk of the technical correspondence. The installation department of the Crocker-Wheeler Company, organized and managed by Mr. Henshaw, had charge of erection work in many well known plants, such as the generators for the Government Printing Office, Washington; U. S. Mint, Philadelphia; Grand Central Station, New York; American Smelting & Refining Company, Perth Amboy; New York Navy Yard; De Lamar Smelting & Refining Company, Maurer, N. J., and many traction power plants, including the Intramural Railway at the St. Louis Exposition.

Mr. Henshaw has been a frequent contributor to the technical press, one of his recent articles being "A Discussion of Systems of Power Supply for Mine Operation" in the "Engineering Magazine" for March, 1905. He has had considerable experience in electrical engineering work for the Government, and a number of his suggestions have been accepted and embodied in the standard specifications of the Navy Department.. Mr Henshaw is a member of the American Society of Mechanical Engineers; the American Institute of Electrical Engineers, the Engineers' Club, and is secretary of the Electrical Department of the Brooklyn Institute of Arts and Sciences, and a past vice-president of the New York Electrical Society.

The Clyde Valley Electrical Power System, Glasgow, Scotland.

FOR many years the Clyde and the neighboring district has been famed as a center of high industrial and engineering importance; and it is the avowed object of the Clyde Valley Electrical Power Company, which was initiated by local enterprise, to help manufacturers in the district surrounding Glasgow to maintain the position they have so long held, and to aid them in competing as keenly as ever in the world's markets. The company was incorporated in 1901, and has obtained powers over an area extending along the Clyde Valley from Craigdoran and Port Glasgow on the west, to Lanark and Shotts on the east. This area, which comprises about 750 square miles, contains the most important manufacturing and coal producing districts in Scotland. The company has taken over the provisional order which was granted to the Burgh of Clydebank in 1901. This was sanctioned by Parliament in 1904 and enables the company now to supply electricity for both power and lighting in that burgh, for which purpose a special plant has been installed.

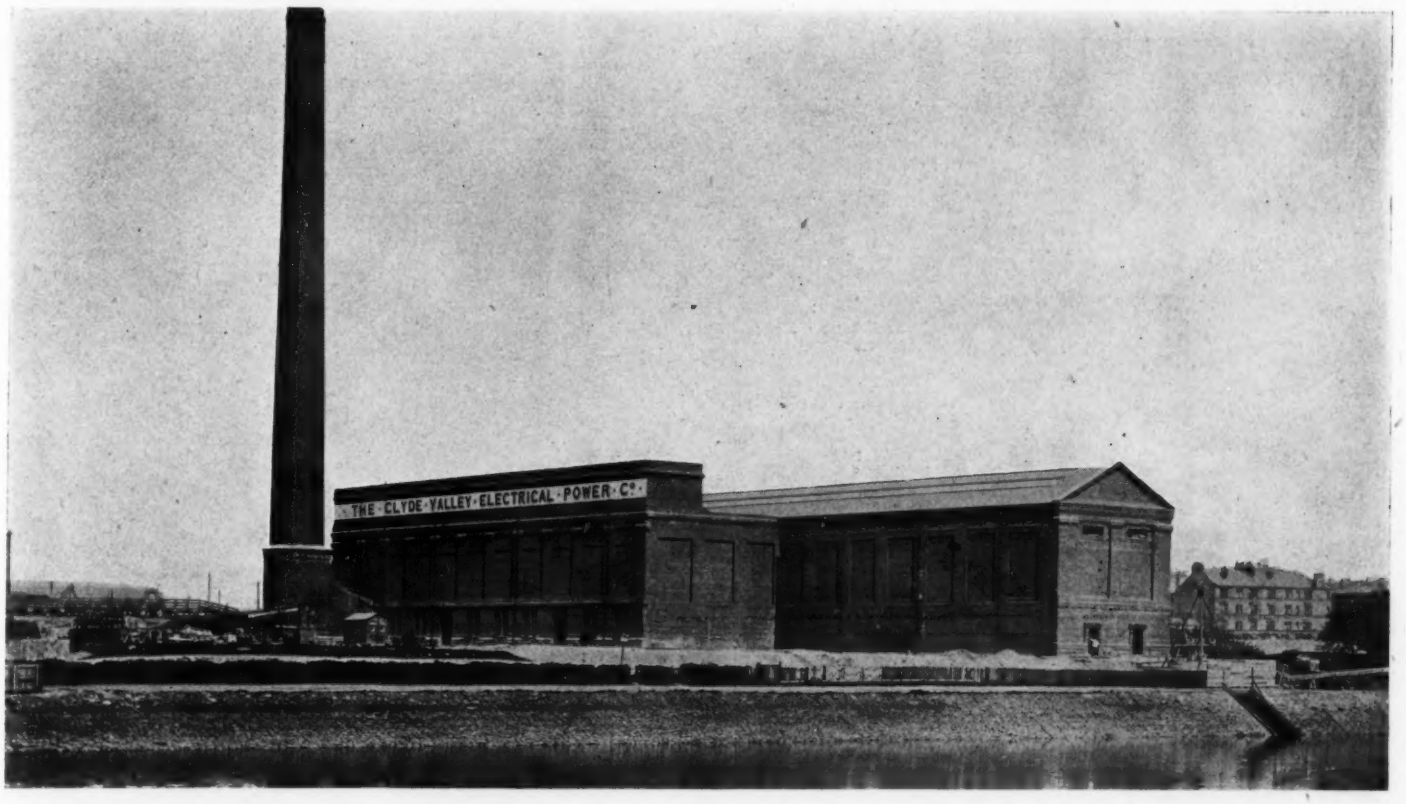


FIG. 1.—YOKER GENERATING PLANT, CLYDE VALLEY SYSTEM.

The city of Glasgow and the burghs of Govan, Partick, Port Glasgow, Paisley and Hamilton, although actually situated in the above area, are not included in the company's schedule unless any of them should elect to take a supply. Under the act of Parliament the company was empowered to acquire land for the erection of generating stations at Yoker and Motherwell, five miles and fifteen miles out of Glasgow, respectively; and in September, 1902, a contract was entered into with the British Westinghouse Electric & Manufacturing Company, Limited, for the erection and equipment of these two stations and the various sub-stations that are dotted over the area.

The Yoker generating station of the system (Fig. 1) is situated on the banks of the Clyde, where an unfailing supply of water for condensing purposes is available. The Motherwell station of the system being situated at a higher elevation, and above the level of the River Clyde, depends for its water supply for condensing purposes on electric pumps working against a head of 140 ft. The offices occupy part of the south end of the engine room, being placed adjacent to the switchboard galleries. Accommodation is provided here for the station superintendent, storekeepers and timekeepers. The offices are divided off from the switch galleries by iron doors and everything is of a thoroughly fire-proof construction, special attention having been paid to this important matter. The two plants at Yoker and Motherwell are very similar in most respects.

The boiler house has an internal measurement of 186 ft. long by 50 ft. wide. It is well lighted, and is designed in every way to afford a maximum of convenience. There are at present four double drum Babcock & Wilcox water-tube boilers in position, each having a heating surface of 4,400 sq. ft. and fitted with superheaters capable of imparting 150° F. of superheat. The steam pressure is 175 pounds per square inch. The boilers are connected to a main flue passing along the back, and a Green's economizer of two sections and 432 10-ft. tubes (Fig. 3) is installed between this flue and the chimney, the usual bye-pass flue being provided.

The chimney is built of special perforated and moulded bricks on the Alphonse Custodis system, and is 225 ft. high above the foundations, with an internal diameter at the top and bottom of 11 and 14 ft., respectively. It is lined with fire bricks up to a height of 85 ft. above the top of the foundations, which extend to a depth in the ground of 22 ft. The base of the foundations occupies a space of 2,116 sq. ft., and the weight divided over the entire area is two tons per square foot, allowance being made for wind pressure.

Each of the boilers is fitted with a Roney mechanical stoker manufactured by the British Westinghouse Company, and adapted for burning efficiently a cheap class of coal. These are driven through special worm gearing by two 4½-in. by 4-in., 5-hp Westinghouse standard engines, running at 400 r.p.m., and situated in the boiler house.

The coaling arrangements of the power station are most complete, and from start to finish the fuel is untouched by hand. Coal is brought in wagons to the company's private siding, where it is dumped by hydraulic ram into the crusher pit, passing through a crusher and screen operated by a 10-hp enclosed shunt motor running at 650 r.p.m. It is there picked up by a bucket conveyor, constructed by Graham, Morton & Co., and carried to the storage bunkers over the boiler house. This conveyor, which is driven by a 15-hp enclosed shunt-wound motor, is also used for carrying the ashes away from the boiler house.

From the bunkers the coal passes automatically to the stokers, being weighed, also automatically, in transit, and the number of hundred weights used recorded on an indicator. To prevent the coal sticking in the shoots a motor-operated agitator is installed, which keeps it constantly on the move.

The engine room consists of two floors, one on the ground level and one in the basement, the latter containing most of the auxiliary machinery. The turbine condensers, which are of the Mirrless-Watson vertical surface type, each with 6,250 sq. ft. of cooling surface, are placed here, their upper ends projecting through the main

floor a few feet. Each turbine exhausts directly into its own condenser and each condenser is provided with a steam-driven, two stage, dry air pump situated in the basement (Fig. 4). Arrangements have also been made for exhausting to atmosphere if necessary.

The circulating water for the condensers is drawn from the Clyde, running by gravity into a large circular well 18 ft. in diameter and of a depth below water level of 9 ft. There are two 30-in. pipes leading into the well from the river and the water is drawn out through a 36-in. cast-iron pipe by means of a steam-driven centrifugal pump placed in the basement.

After passing through the condensers the water is discharged by a 36-in. pipe into a tank on the bank of the river. The condensed water is pumped into the hot well, which is also in the basement, by a centrifugal pump driven by a 6-hp, vertical shaft, shunt-wound motor, running at 625 r.p.m. From here it passes to the suction of the two feed pumps, which are of the J. & P. Hall & Sons' tandem compound, double-acting type, each capable of delivering 9,600 gallons per hour against a boiler pressure of 175 pounds. The make-up water is taken from the city mains, that of the Clyde being unsuitable for boiler feed purposes; there is, however, a standby suction from the river for use in case of emergency.

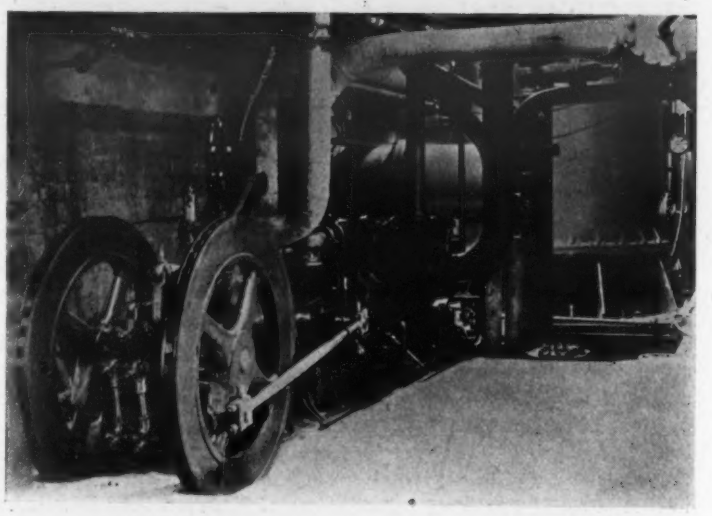


FIG. 4.—TWO-STAGE DRY AIR PUMP FOR TURBINE CONDENSER.

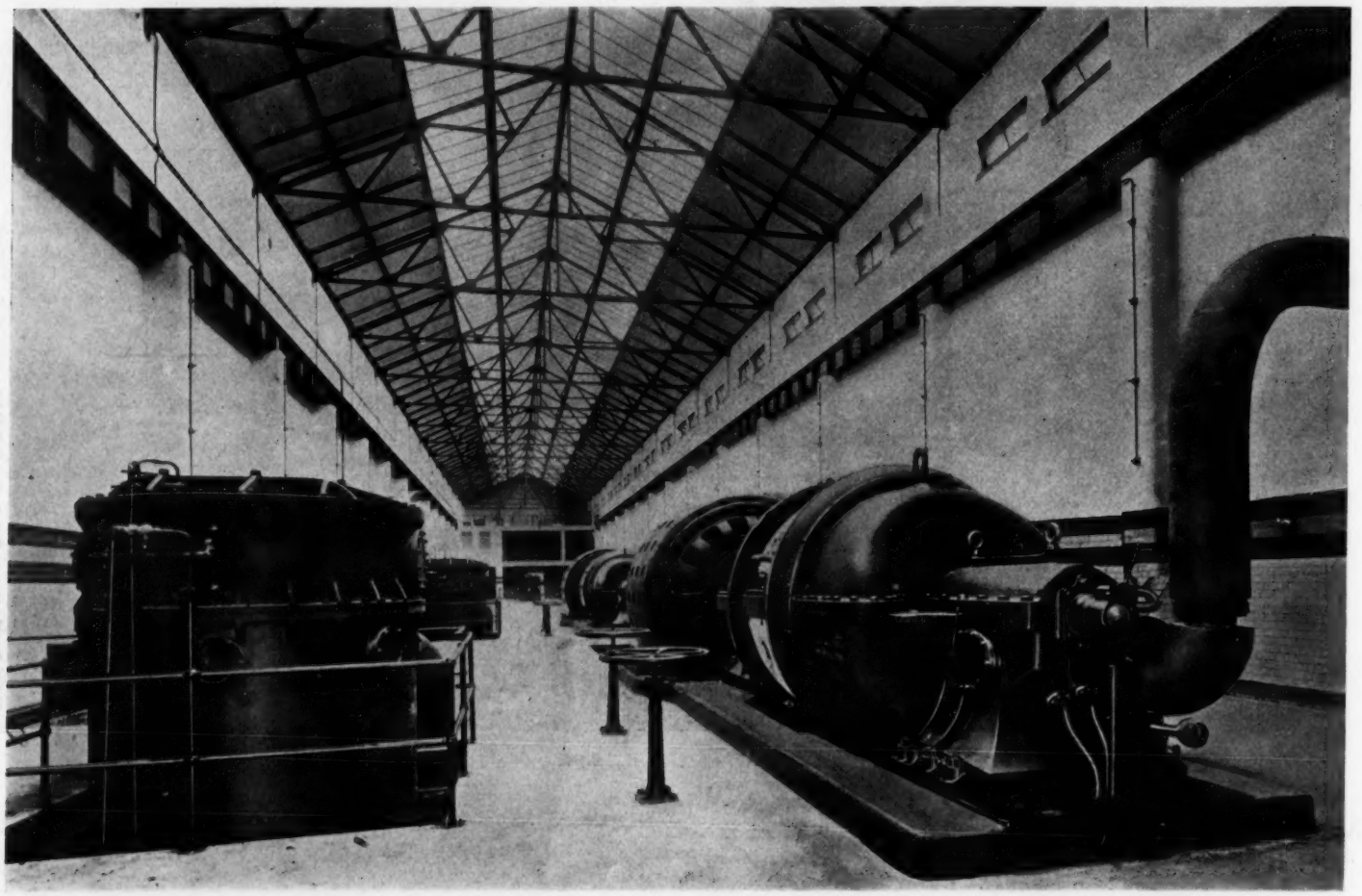


FIG. 2.—INTERIOR OF YOKER PLANT.

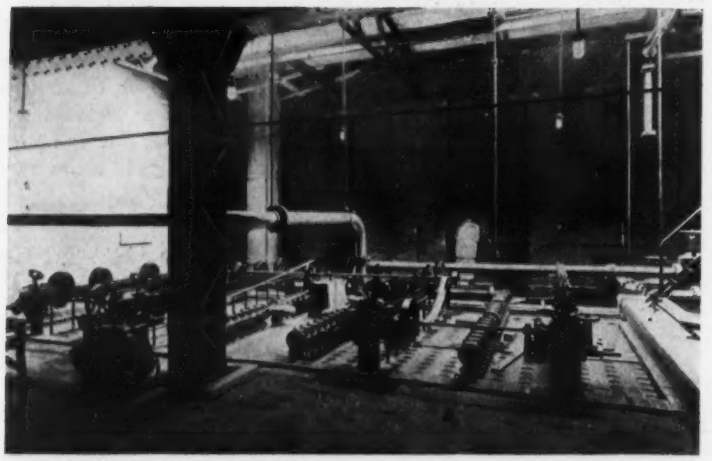


FIG. 3.—VIEW OF ECONOMIZERS.

The exciter sets have their separate surface condenser, which is of the Worthington Pump Company's make, and has 600 sq. ft. of cooling surface. In addition to the above auxiliary plant there is installed a feed water heater by Joseph Wright & Co., having a heating surface of 700 sq. ft.

The upper and principal floor of the engine room measures 252 ft. long by 43 ft. 5½ in. wide. It is well lighted from the roof, the walls are faced with white glazed bricks, and the floor throughout is paved with Italian mosaic work. At the north end are situated the switchboard galleries and offices, which have an inside measurement of 53 ft. by 43 ft. 1 in. wide.

The main generating plant at present installed consists of two Westinghouse-Parsons steam turbine units (Fig. 2), each with a normal capacity of 2,000 kw and an overload capacity of 3,000 kw. The speed is 1,500 r.p.m., which corresponds to a peripheral velocity of the rotating part of five miles per minute. The turbines are of the latest double-flow pattern, steam entering at the center and exhausting at both ends, and each contains no less than 20,000 blades.

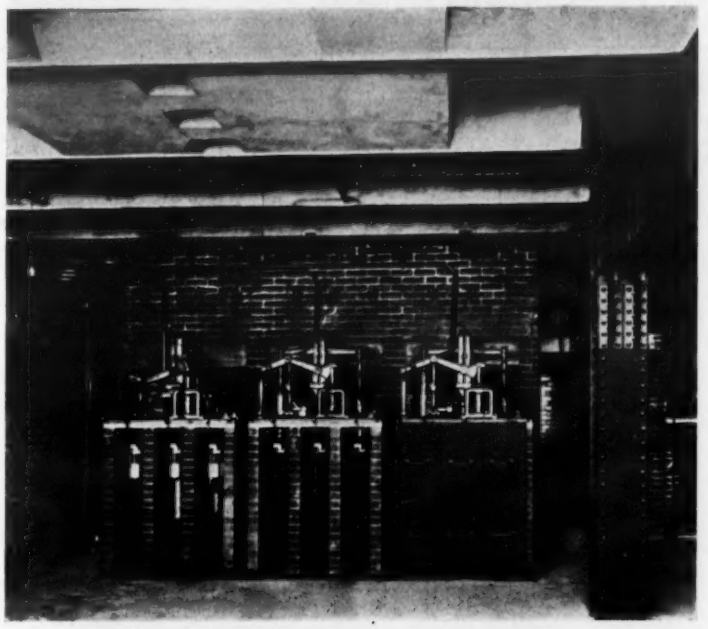


FIG. 5.—SWITCH GEAR, GROUND FLOOR.

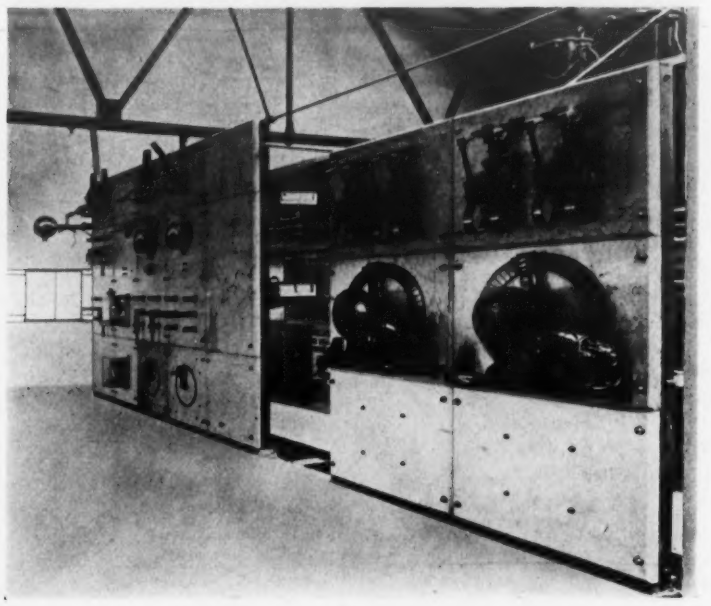


FIG. 8.—AUTOMATIC RHEOSTATS.

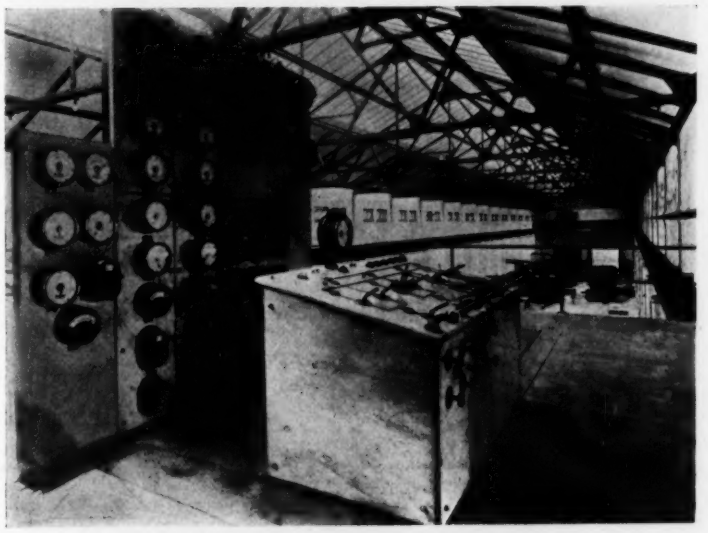


FIG. 6.—TOP GALLERY OF SWITCHBOARD.

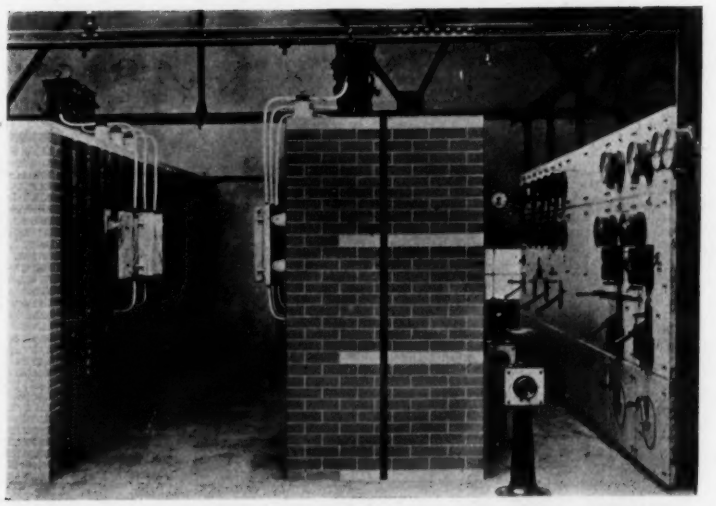


FIG. 9.—BUS-BAR CHAMBERS AND MOTOR-GENERATOR SWITCHBOARD.

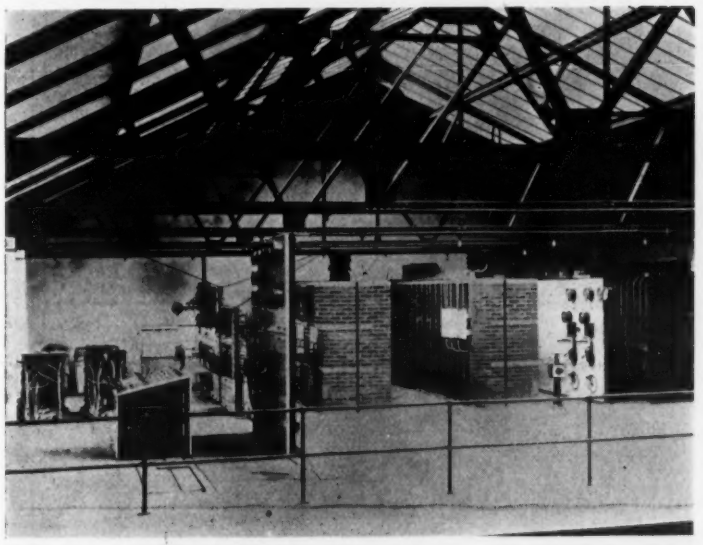


FIG. 7.—GENERAL VIEW OF TOP GALLERY.

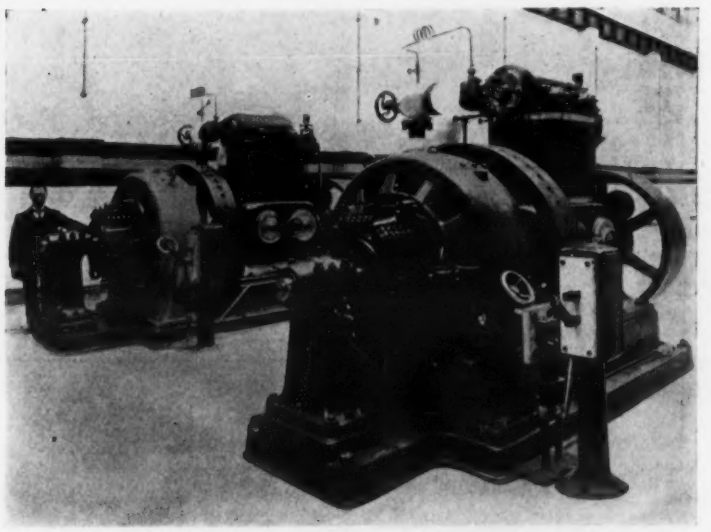


FIG. 10.—EXCITER SETS.

THE CLYDE VALLEY ELECTRICAL POWER SYSTEM, GLASGOW, SCOTLAND.

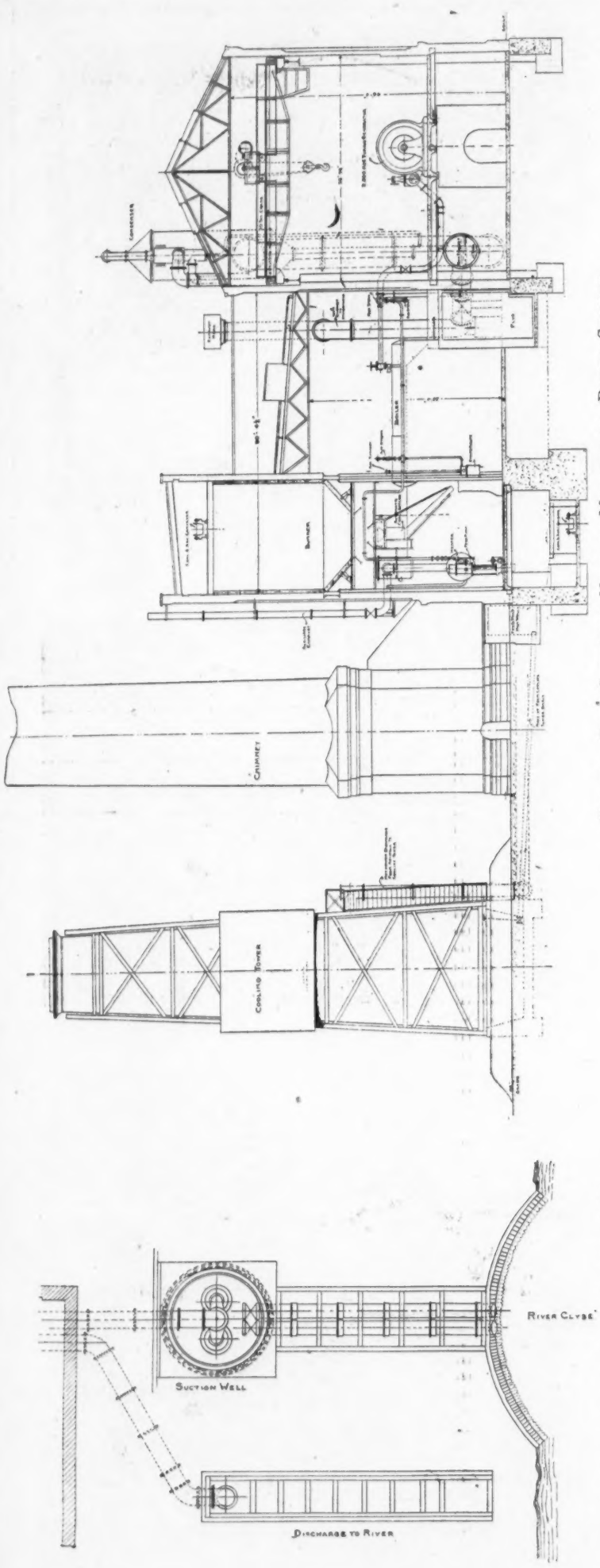


FIG. 12.—CROSS-SECTIONAL VIEW OF MOTHERWELL POWER STATION.

FIG. 11.—PART PLAN OF YOKER POWER STATION.

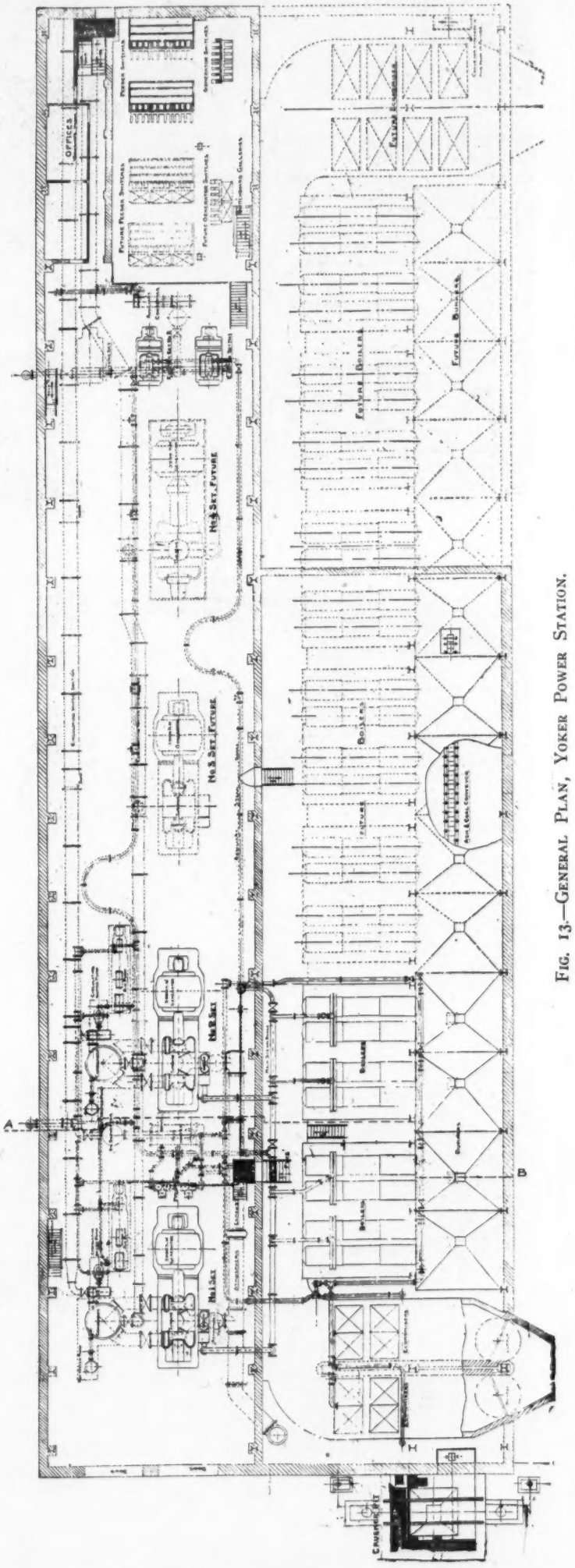


FIG. 13.—GENERAL PLAN, YOKER POWER STATION.

THE CLYDE VALLEY ELECTRICAL POWER SYSTEM, GLASGOW, SCOTLAND.

These are securely fixed to the steel drum and are of drop forged steel in the first series and special metal at the low-pressure end so as to prevent corrosion due to the wetness of the steam. The cylinder is of close-grained cast iron and the rotor consists of a rolled steel drum fixed to the shaft by the aid of forged steel umbrella-shaped discs shrunk into the drum and pressed on the shaft.

Each of the turbines is directly connected to a Westinghouse 2,000-kw, 11,000-volt, three-phase, 25-cycle generator of the rotating field type. These are of the normal Westinghouse design. The two-pole field magnets consist of a solid forging of Whitworth fluid pressed steel combining high magnetic properties with strength, and the armature of laminated iron wound with copper bars in practically closed slots is supported by a heavy cast-iron frame divided horizontally. The starting, stopping and speed variations of the generators are under control from the switchboards by electrical means, current for this purpose being taken from the exciters (Fig. 10).

The oiling of the turbines is carried out on the gravity system. A large tank in the basement of the engine room receives the oil overflowing from the bearings, which is then passed through coolers and raised by a special oil pump to a tank in the roof of the boiler house, flowing from thence by gravity under a head of 50 ft. back

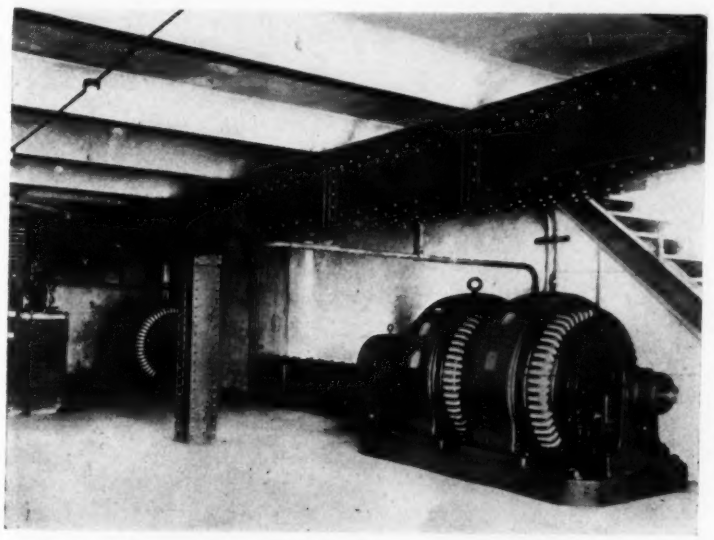


FIG. 14.—MOTOR-GENERATOR SET IN SWITCH GALLERY.

to the bearings. Oil pressure gauges are provided on the latter in order to indicate at a glance how the apparatus is working.

The engine room as at present constructed will accommodate one more 2,000-kw set and a fourth unit of 3,500 kw, which will eventually make the total capacity of the station 9,500 kw. The additional sets will be added as soon as one of the present units is loaded up, so that there will be always one spare ready at any moment in case of accident.

The two exciter sets (Fig. 10), situated at the south end of the engine room, are each capable of furnishing the exciting current for both the main generating units at present installed. They are of 75 kw capacity each, and consist of a Westinghouse 11-in. by 19-in. by 11-in. vertical compound engine, running at 290 r.p.m., coupled direct to a 125-volt, compound-wound dynamo.

In addition to their natural function these exciters supply current for operating the motors of the coal and ash conveyor, crushers, agitators, economizers, pumps, traveling crane, etc., and also for the electrically operated main and other switches.

The traveling crane was furnished by Messrs. G. & A. Musker & Co., and in the case of the Yoker plant has a span of 42 ft. It is of 30 tons capacity, of the three-motor type, these being of the Westinghouse type SB, totally enclosed pattern, series wound. The motors are of the following horse-powers and speeds: Lifting, 25 hp, 460 r.p.m.; longitudinal travel, 10 hp, 650 r.p.m.; transverse travel, 4 hp, 935 r.p.m.

The whole of the switch gear is contained in the three galleries at the south end of the engine room. That on the ground floor (Fig. 5) and the first gallery consists of the oil switches and feeders. On the third or top gallery of the switchboard (Figs. 6 and 7) are placed the main bus-bars in brick compartments and the main controlling board, as well as the resistances, etc. Following the latest practice, the control board consists of a small desk directly facing the various instruments such as ammeters, voltmeters, power factor indicators, relays, etc. All the main switches and smaller gear are electrically operated from this desk by the exciter current as before mentioned, and the speed of the turbo-generators and their starting and stopping is also controlled from here (Figs. 8 and 9).

The Yoker and Motherwell power stations are, as already noted, of the same size and almost identical in arrangement; the foregoing description, therefore, applies generally to both, with the following exceptions. The Motherwell station is not so favorably placed as Yoker, being 400 yards from and 140 ft. above the level of the river. A cooling tower of Balcke make has, therefore, been installed for cooling the circulating water. It is of the natural draught, enclosed type, 73 ft. high, and is constructed entirely of wood thoroughly soaked in carbolineum of the best quality. The tower has a normal capacity for cooling 220,000 gallons of water per hour from 120° F. to 80° F. when the temperature of the air is 70° F. or less; and the amount evaporated under ordinary conditions of atmospheric temperature does not exceed 2½ per cent of the water circulated.

The condensing plant is another of the features in which the Motherwell station differs from Yoker, a barometric jet condenser being installed. This is capable of giving a vacuum of 27.5 in. when dealing continuously with 80,000 pounds of exhaust steam per hour, if supplied with 348,000 gallons of circulating water per hour at a temperature of 80° F. In connection with this condenser there are installed at Motherwell two Alberger-Corliss two-stage dry vacuum pumps, one of which is capable of dealing satisfactorily with the air in the condenser when one turbine only is in operation. The dimensions of these pumps are as follows: Diameter of steam cylinder, 10 in.; diameter of air cylinder, 24 in.; stroke, 24 in. Their normal speed is 100 r.p.m., but they are capable of working at a lower rate if necessary. The steam and exhaust valves are of the Corliss type, and so designed as to permit of a high speed in cases of emergency without noise or jar.

Six feeders are provided for distribution from Yoker, and all are protected where they enter the building in the basement by Westinghouse lightning arresters. The cables for supplying power to any part of the district between Clydebank and Scotstoun, as well as to Temple, are practically finished. They are all laid in duplicate, so that in case of any accident happening to one of them the spare one can be connected immediately, while the duplicate is being repaired.

As previously stated, the Clyde Valley Electrical Power Company is authorized to supply in the adjacent Burgh of Clydebank. For this purpose special plant has been installed at Yoker consisting of two 150-kw motor-generator sets (Fig. 14). Each set is provided with a small motor coupled direct to the shaft, which serves for starting and running up to speed. The motor-generators are situated in the first switch gallery of the Yoker power station, and the switchboard controlling the distribution to this area is placed on the top gallery.

Both the high and low-tension cables for the Clydebank district were supplied and laid by Messrs. Henley & Co., and the British Insulated Wire Company has been entrusted with the extra high-tension cable work throughout the entire area. The number of substations at present installed in the layout of the scheme is ten for the Motherwell district and two for Yoker.

The general arrangement of the entire plant was designed by Strain & Robertson, consulting engineers, of Glasgow. Mr. H. A. Barnett, resident engineer to the Clyde Valley Company, has had the supervision of the erection and installation of both power stations and the distribution system since the commencement. The data here given are due to the above-mentioned gentlemen and to Mr. D. A. Starr, general manager of the Clyde Valley Company, who has also kindly furnished assistance in the preparation of this description.

Memorials to Davy and Faraday.

Last month at Clifton, England, Mr. G. Marconi unveiled a memorial tablet to Sir Humphry Davy. The tablet is on the house at Rodney Place, where Davy and other celebrities lived. During July also, the London County Council opened a new park or small "breathing space" in Walworth and named it the Faraday Garden, after Michael Faraday, who was born in the district in 1791.

Utilization of Gas Engines in Connection With Long-Distance Electric Transmission.*

BY JOHN MARTIN.

THE very rapid progress in the development of electrical machinery and appliances during the past ten years has invited the capitalist and engineer to install and operate many hundred thousand horse-power, utilizing the waters of the various streams, as a source for generating the current. The prime incentive for such development from the investor's standpoint was the fact that the source of power was being constantly renewed by the laws of nature, and with the authentic records of precipitation as a guide, the prudent engineer has recommended a great many plants to be constructed, which have proven financially and commercially successful. The most notable examples of this progress have been, and are being, developed in the State of California. A great many surprises of a practical nature have been encountered by the managers of these various water power electric developments with particular reference to earning capacity, and more particularly with reference to the relation of "plant utility to plant capacity," commonly termed "load factor." The manager is constantly trying to find ways and means of utilizing the electric current during such times of the day or night when his present consumers do not require it. Numerous plans and devices have been utilized to further this end.

Within the past year the problem was presented to the officers of the California Gas & Electric Corporation, who were desirous of furnishing all the electric current for the operation of the street railroads under the control of the United Railroads of San Francisco, and negotiations were commenced with the officers of the latter company, with that end in view. It was very difficult for the railroad people at first to develop even a hope that such a condition of affairs could be made feasible. Here was a company with its thousands of horse-power developed at no point nearer than 140 miles from the proposed place of consumption, and while it is true that this company has many sources of supply and many avenues of delivery, yet there was an insurmountable barrier in the minds of the railroad people as to the advisability of purchasing current at any price if the convenience of its patrons was to be sacrificed in any way. As one of the officers of the railroad company remarked: "We certainly desire to save money in the operation of our property—within reason—but at the same time we care more for the good will and satisfaction of our patrons; and if any interruption of service should occur on all your lines feeding into this city at one time, we cannot expect our citizens to be patient while sitting in the cars for an hour and a half, until you get up steam." The railroads are operating their steam plant for this service, and the power company suggested the continuance of the operation of these steam plants, and receiving a portion of the power from the power company, but this plan was not considered advisable.

After numerous interviews with an honest desire on both sides to try and accomplish the economic result, if it could be done without sacrificing the interests of the patrons of the railroad company, a firm conclusion was reached that in a service so large and important as the carrying of hundreds of thousands of people daily in a large city, nothing could be done on the plans outlined, unless some absolute guarantee of continuity of service were available, and it certainly was not favorable from the standpoint of the utilization of steam engines for emergency purposes, because if steam were being maintained constantly under the boilers, no economy could result, and if the plants were allowed to cool off the time element of starting would prohibit their use. The officers of the power company had been making thorough investigations of the development of the gas engine in large units, having sent two of their engineers throughout the entire East to make full and complete reports. In consequence, and as a last resort, the power company agreed to install three gas engine electric generating units, each unit having a capacity of 4,000 kw, or a total initial capacity of 12,000 kw. This plant will be enlarged as rapidly as the requirements of the railroad may demand.

The guarantees which have been made by the manufacturers of these engines are particularly interesting, and if successful will undoubtedly place long-distance electric transmission in a position to practically guarantee continuous service, regardless of the length of its transmission lines or the momentary interruptions which do occur through causes beyond human control.

It might be fairly stated that the gas engine stands alone as the only means of instantaneous generation of electric current at distributing centers in times of emergency, at any fair or reasonable cost. The gas engine electric generating plant of the California Gas & Electric Corporation will also be utilized to a certain extent for the purpose of increasing the load factor of the transmission line, for it is obvious to those familiar with power transmission plants that after proper installations have been made, including full capacity at the hydraulic end, as well as in the power house, and in pole lines, there is absolutely no increased cost for current to the power company, whether its load factor be .2 or .99, and any device which can be utilized to improve that load factor adds that much income and net profit for the power plant. In this particular case the gas engine generating plant was a necessity, for without which the California Gas & Electric Corporation would have been unable to have obtained the contract for power. That being the case, the officers decided to make a virtue out of this necessity, and up to the extent of the cost of fuel being less than the increased value derived from improving the load factor on the power lines, they propose to operate this gas engine plant in that manner and for that purpose.

The gas which will be used to drive these engines will be manufactured from crude oil and will be of the quality similar to the illuminating gas now being distributed throughout the State of California manufactured by this process, ranging from 610 to 660 B.T.U. per cubic foot.

Nearly all of the gas engines in use throughout the East and Europe are utilizing producer gas or blast furnace gases, except in very small units or where natural gas can be obtained, and from investigations which I have made I have ascertained that the largest gas engine using manufactured gas of more than 600 B.T.U. has a rated capacity of 300 hp, while those in process of installation near San Francisco will, in each case, be more than seventeen times as large. The nearest approach to these large engines in size are two, which are in operation at Hastings, W. Va., each having 4,500 hp capacity, and driven by natural gas, and being used for the compression of natural gas for transmission through a pipe line 200 miles in length. These engines have been and can be started from cold and rest to full load in less than 60 seconds.

These gas engines are now being built by the Snow Steam Pump Works, of Buffalo, N. Y., and in general design and detail resemble very closely a modern high-grade, massive American steam power engine. They are of the horizontal, twin tandem, double-acting, four-cycle type, giving two impulses to each crank per revolution. This is equivalent to a cross-compound steam engine. Any cylinder head can be removed from any cylinder by simply disconnecting one jacket water supply pipe and removing the nuts holding the head to the cylinder. All working parts are above the engine room floor, nothing but water supply, gas, air inlet and exhaust pipes are below the floor, and these are arranged so that they can be trenched. All the main parts have their proper relative positions positively and permanently fixed by male and female centering fits of large diameter, thus practically insuring self-alignment. Lubrication of the cylinders is effected by spreading. This is accomplished by leading four oil feeds, fed by individual oil pumps, to each cylinder, and entering the cylinder at points to successfully effect the proper spreading of the oil. The oil is fed to the cylinder on the inhalation stroke, and is spread on the compression stroke, thus being properly lubricated for the power or impulse stroke. The lubrication of journals is effected by means of a positive feed lubricator. Each oil feed is carried to the part to be lubricated by means of small tubing leading from a multiple feed oiler containing a small oil pump for each feed led therefrom. The feed to each part is positive and can be adjusted to give a fixed supply of oil per revolution of the engine. When the engine stops the oil feed stops, and when the engine starts, the oil feed also starts. Inlet valves, mixers and cut-off valves will be designed so that gasoline can be injected to the surfaces necessary to be cleaned, rendering the dislodgment of any deposit an easy matter without removing the parts. The pistons are carried by cross heads, thereby materially reducing the weight carried on the bore of the cylinders. By the use of three cross heads the main, intermediate and outboard proper alignment of the pistons is permissible after years of service, and it is questionable whether an engine without this feature can be regarded as entirely satisfactory.

The question of regulation in the generation of electric current by means of direct-connected electrical generators, has been a prob-

*A paper read before the Pacific Coast Gas Association.

lem not only for the gas engine people, but for the steam engine manufacturers to solve, and this has been done in the latter case within the past two years, practically to the satisfaction of the electrical engineer, so that parallel operation is now successful. The builders of this engine are also following steam practice in this respect, and will be able to keep the angular variation within each revolution at a minimum, satisfactory to the electrical generator manufacturers. The main shaft will be of the over-hung crank type, having the cranks forged with the shaft and with crank pins forced into the cranks. The main connecting rods are simple, plain, with solid adjustable stub ends. The main cross heads are fitted with adjustable babbitted gibs and removable crucible steel wrist pins. The pistons are designed in such a way that expansion of the faces can take place without affecting in any way the strength or life of the piston. Piston rods extend from the main cross heads clear through the cylinders to the outboard cross heads and secured to same by nuts. Each cylinder is made in two parts, the joint being circumferential and located half way between the ends. Separate supply pipes for each individual part to be water-jacketed, will be furnished so that the amount of water fed to each part can be regulated, thus permitting the carrying of high temperatures in such parts as cylinder heads, medium temperatures in cylinder jackets, low temperatures to the rods, pistons and metallic packing. These engines are started by the use of compressed air on storage in compression tanks. Safety devices are provided which carefully control the speed limit.

The dimensions of these engines are very interesting: Length over all, 70 ft.; width over all, 34 ft.; weight of heaviest casting, 60 tons; diameters of cylinders, 42 in.; length of stroke, 60 in.; main journals, 30 in. diameter, 54 in. long; main cross head gibs, 27 in. wide, 54 in. long; diameter of center of shaft, 38 in.; weight of fly-wheel, 130,000 pounds; total weight of engine, fly-wheel and generator, 1,200,000 pounds.

These engines will probably be in operation on or before January 1, 1906, and from all the investigations which have been made by my co-workers we are laboring under no doubt as to the absolute success of this installation when completed.

Recent Developments in Three-Phase Traction on the Valtellina Road.

WE have had occasion frequently to refer to the electrical equipment of the Valtellina Railway in northern Italy, upon which considerable interest has been centered on account of the pioneer work undertaken in connection therewith. It will be recalled that the road uses high-voltage, low-frequency, three-phase currents, and represents one of the earliest installations to adopt alternating-current motors. It is believed that a report of the recent developments on that railway will prove of special value in view of the experience obtained with the equipment.

Both the current-taking device and the water rheostat, which were severely criticised when first proposed, have given excellent satisfaction in actual practice. The current collector consists of two long rollers mounted on the same wooden shaft and rotating in ball bearings. The current is taken from them by carbon brushes. As an advantage offered by this system of current collection, it may be stated that after three years of actual service it is not possible to measure any diminution of the section of the trolley wires. The

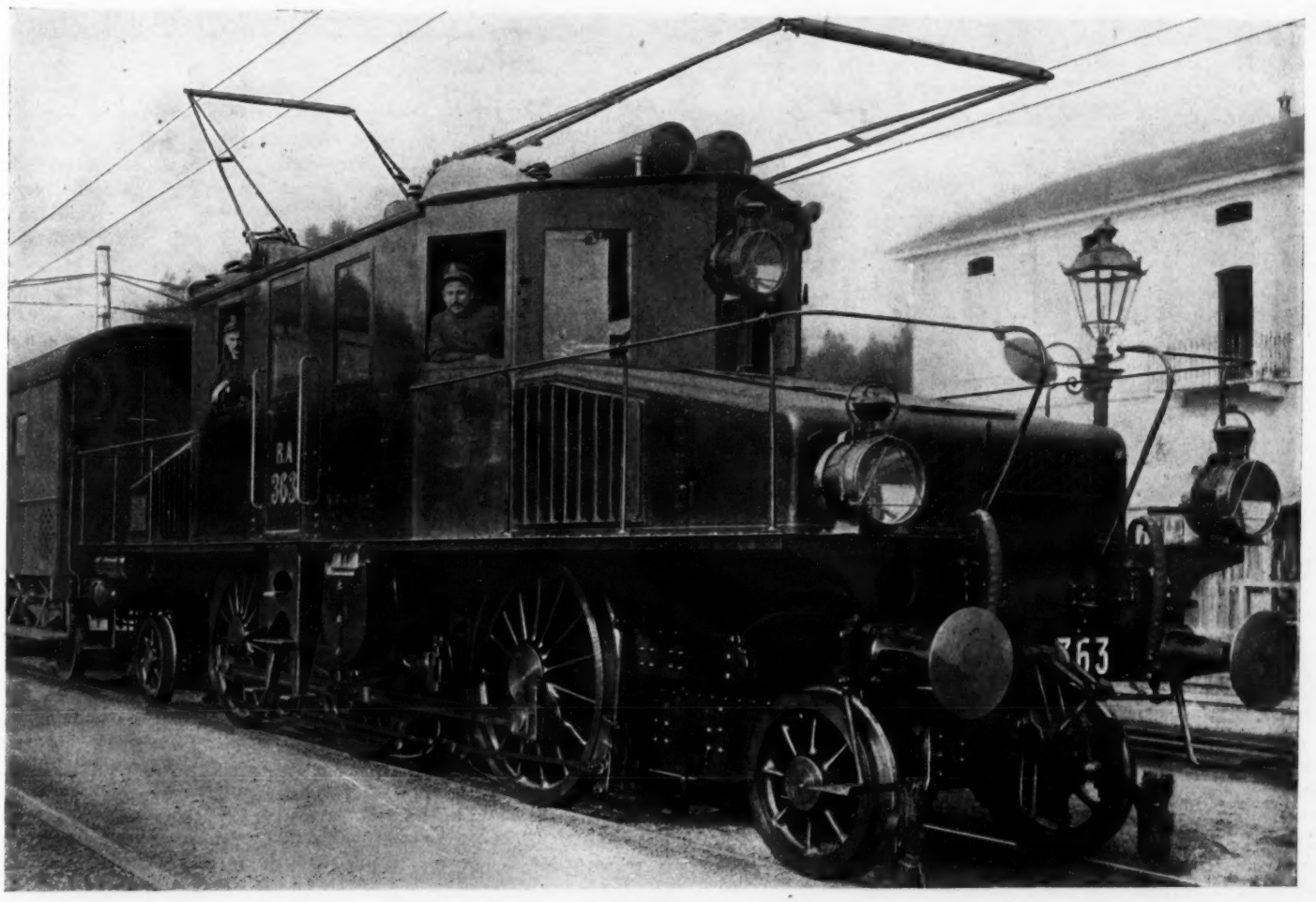


FIG. 1.—THREE-PHASE LOCOMOTIVE.

Valtellina line was the first to use the water rheostats as starting devices for traction purposes. Compressed air moves the water to and from the plates of the rheostat, producing a contact of a more or less broad surface and thereby varying the resistance. In the early periods of the service the cooling of the water was not quite sufficient, owing to the fact that the rheostats were originally calculated and constructed for a smaller capacity. But after the necessary alterations were made the water rheostats proved more suitable for railway service than metallic ones. Their weight is less; moreover, repairs which, in the case of metallic rheostats, are sometimes very troublesome, are practically avoided, as water rheostats do not burn when overloaded, nor does solder melt out. The worst that can happen is that the water evaporates. Accordingly, the overload capacity of the rheostats is large. Starting can also be effected very smoothly, as there are no steps in going from one speed to another.

One important result of the Valtellina installation is the proof furnished that the small air-gap in three-phase traction motors does not interfere with the safety of the railway traffic in any way, supposing the bearings are properly designed. Most of the motor cars have run over 100,000 miles, and it has not yet been necessary to change the bearings or to renew the bushes. Only two or three breakdowns have occurred that were due to the burning out of the bearings, and all these cases were caused through the carelessness of the attendant in forgetting to oil the bearings. A great deal has been said, also, in technical periodicals about the difficulty of using two overhead wires in switches and station yards. They are said to be complicated and to involve a constant danger to railway working. The cost of maintenance and repairs of the air switches has been only a very small percentage of the whole cost of maintenance of the overhead line, and quite unimportant.

The first electrical equipment of the road included motor cars for passenger trains and locomotives for freight trains. In extending the service, however, the company decided, after a careful study of the question, to employ electric locomotives for all purposes. This decision was reached partly because the line connects with others, and the use of through cars was thought to be a convenience, and partly because it was thought the cost of inspection and maintenance would be smaller.

For the motor cars and the first locomotives, there were used direct-coupled motors with a flexible coupling between axle and motor. This method of driving has proved to be quite practical, and to work satisfactorily in every respect. Direct coupling has, nevertheless, great drawbacks in the eyes of the railway engineer,

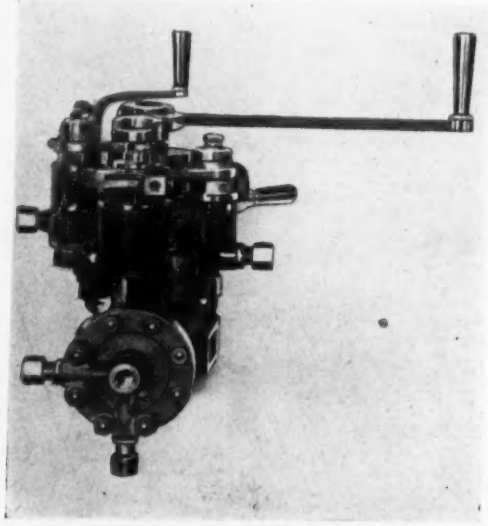


FIG. 2.—PNEUMATIC MASTER CONTROLLER.

especially in the case of induction motors. As the casing of the latter is not made of two pieces, it cannot be opened, and in case of any repairs on the windings, the wheels have to be pressed off the axles. For the new Valtellina locomotives, therefore, the following solution was adopted: The motors run with the same number of revolutions as the driving axles, but are mounted between the two axles and drive the axles with cranks and coupling rods. The main advantages to be claimed for this design are: The motors, being built in between two axles, may easily be taken out for repairs and can be replaced by other motors. The slippings and brushes of the motors are put outside of the locomotive frame, the use of such a design enabling ready access to those parts of the motors which require attendance and revision. As all driving axles are driven by all motors with the same mechanism, there is no danger that different loads are thrown upon the individual motors, or that one of the driving axles should slip. The mechanism has no dead point, the cranks on the two sides being keyed at a different angle of 90°. This mechanism has only rotating parts, which can be completely balanced by counterweights, so that no disturbing oscillations can arise by unbalanced masses, as in the case of steam locomotives. The energy losses in the mechanism are small, whereas the piston rods and connecting rods cause the most friction in the mechanism of a steam locomotive. The weight of the motors has no hammering effects on the rails, as all parts are spring supported.

Figs. 1 and 2 show the general design of these locomotives. They have ten wheels (five axles), six of them being driving wheels. The total weight of the locomotive in working order is 62 tons, 42 tons being divided as adhesional weight on the three middle axles, and 20 tons as dead weight on the first and fifth axles. Each locomotive is driven by two motors, one of which is placed between the second and third axle, and the other between the third and fourth one. The locomotive has only one fixed axle, viz.: the middle one. The other two driving axles have a range of movement sideways of about 1 in. At both ends of the locomotive there is a pony axle (a leading and trailing axle, respectively), both having a radial movement. One of them also has a lateral movement. This portion of the design is not new, as it has been used with the best results with steam locomotives of the Adriatic Railway and was designed by the company's own engineers. The electric locomotive can be run equally well in both directions.

The two motors of each locomotive are of the same type. (See Fig. 3.) Both are double motors uniting a high-tension and a low-tension motor on the same axle and in the same casing. Both halves of these twin motors have eight poles, and hence at 15 cycles the number of revolutions is 225 per minute, or when working in cascade 112.5 per minute. During official tests they have repeatedly developed double their normal tractive force, even when the voltage dropped about 25 to 30 per cent. The two halves of the twin motor have common slip rings. When the group works in single, only the high-tension motor is switched in, and then its rotor is short-circuited through the slip rings. When the two motor halves work in cascade, the slip rings are not used at all, since the two rotors are connected together and the stator of the second motor is short-circuited. In cascade connection each pair of motors is combined in such a manner that the primary of the one (the high-tension motor) is connected to the line, whereas its secondary is connected to the primary of the other motor. The secondary of the second motor is either connected to the rheostat or short-circuited. In single connection each motor used is independently connected to the line.

The locomotive is provided with the same system of current collectors as has been used on the other vehicles of the Valtellina Railway. That is, two pairs of current-collecting rolls are used, working alternately, corresponding to the two directions of the run. (See Fig. 1.) The current-collecting rollers are pressed against the overhead wires by compressed air, which is conducted into the cylinders of the under frame; in order to lessen the shocks in raising or lowering the current collector, a glycerine dash-pot is used. Moreover, the experience gained during the operation of the Valtellina line has been utilized, viz.: that the current collectors give greatest satisfaction when pressed to the overhead wires with a strain corresponding to the running speed. Accordingly, two degrees of pressure are provided, corresponding respectively to the two main speeds of 64 and 32 km. per hour. When inserting the trolley valve, compressed air is admitted only to the surface of the main piston, corresponding to the lower speed. When regulating with the pneumatic master-controller up to the higher speed, compressed air passing through the bore of the piston rod is simultaneously admitted on the surface of the auxiliary piston, which further presses the trolley spring and causes a greater pressure on the wires. The pressure on the contact wires by the current collector at the smaller speed is 6.6 kg. (14.5 pounds); at the higher speed, 8.5 kg. (18.7 pounds).

The entire connecting and regulating apparatus of the motors is operated through two pneumatic master controllers fitted at both sides of the locomotive. The pneumatic master controller, Fig. 4, is a combination of valves. It has three levers performing various functions and being interlocked. The main lever, which is also a starting lever, serves for operating the starting and regulating valve. At standstill the starting lever stands vertically to the longitudinal axle of the locomotive. At starting the locomotive driver pulls the starting lever toward himself, when it describes a certain angle and is brought in its first position at which it acts upon the starting lever and thus admits compressed air to the primary switches and rheostat switch heads. In this way the primary switches are first thrown in, while the rheostat heads are brought into a position at which, while not yet in circuit, they are ready to be acted upon by the regulating valve. When the lever is further turned the regulating valve begins to act and effects the insertion of the water rheostat. The second, shorter lever, below the starting lever, is the reversing lever and acts upon the reversing valve. The outward position of this lever makes the locomotive run forward, whereas if the lever

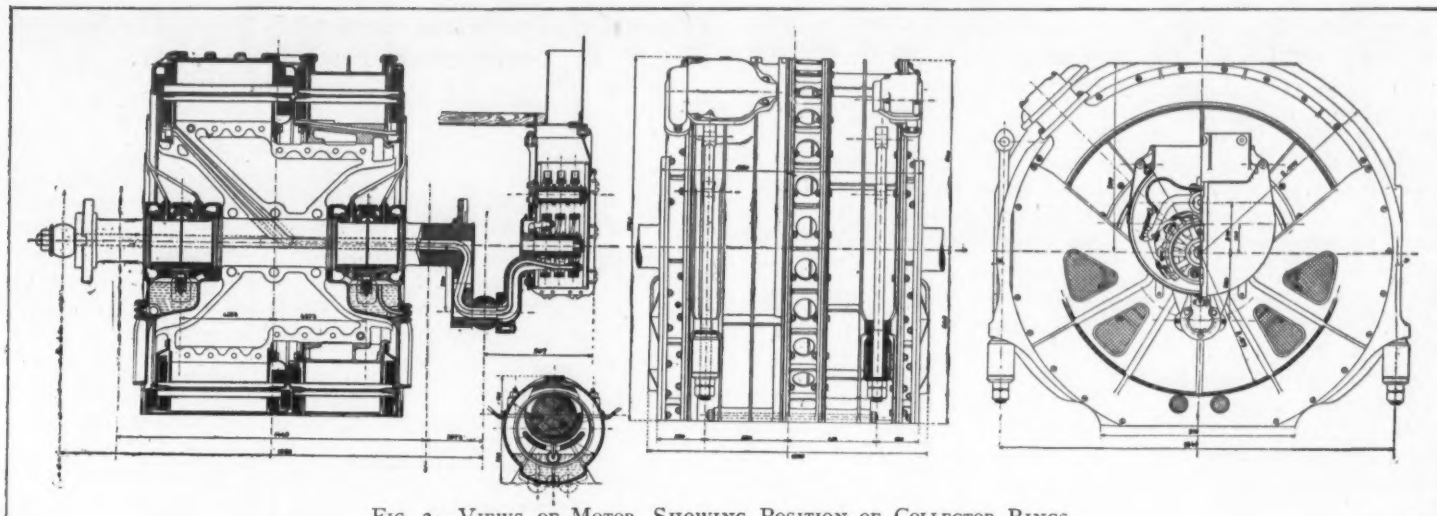


FIG. 3.—VIEWS OF MOTOR, SHOWING POSITION OF COLLECTOR RINGS.

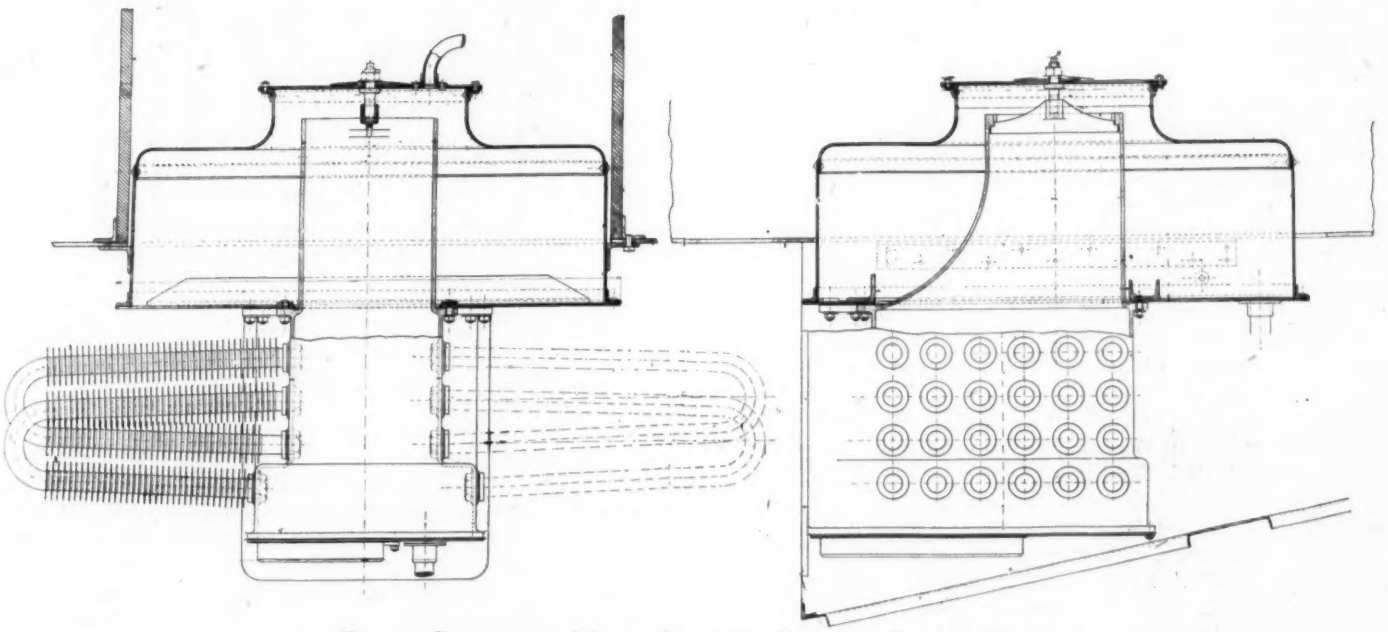


FIG. 4.—SECTIONS OF WATER RHEOSTAT, SHOWING COOLING COILS.

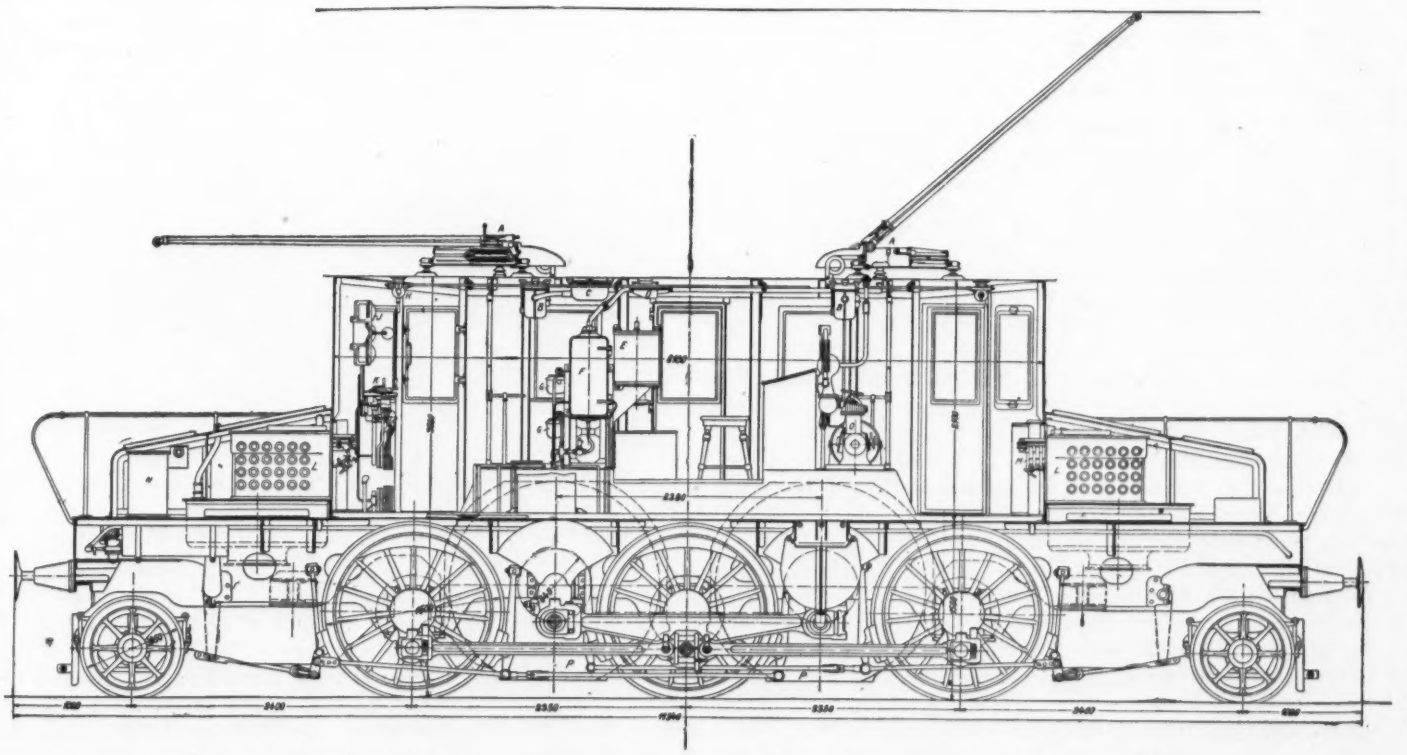


FIG. 5.—VIEW OF LOCOMOTIVE, SHOWING POSITION OF DRIVING MOTORS AND CONNECTING RODS.

RECENT DEVELOPMENTS IN THREE-PHASE TRACTION ON THE VALTELLINA ROAD.

is thrown toward the inside, the locomotive moves backward. The regulating valve has two openings, which are connected with the corresponding parts of the air pistons of the primary switch. According to the position of the regulating valve these openings are connected either with the air tank or with the open air. The third lever at the left hand from the starting lever, is the speed lever, and connects the motors either in cascade or single. The various levers are interlocked in such a manner as to allow of the reversing lever and speed-regulating lever being moved only when the starting lever is in its initial position, so that both the primary switch and the rheostat are disconnected. On the other hand, the starting lever can be moved only when the two other levers are in their end positions.

For every twin motor there is a water rheostat (Fig. 4) which consists of a vessel made of two parts. In one part three groups of sheet-iron plates are suspended. When not in circuit the water does not touch the sheet-iron plates. When the rheostat is thrown into circuit compressed air is admitted into the other part, forcing the water upward around the plates. The more air is admitted to the rheostat, the greater will be the surface of the plates in contact with the water until the resistance becomes a minimum. The connections from the three secondary motor ends are finally united directly together.

The experience on the Valtellina line shows that safety, in connection with high-tension current for electric traction, is only a question of good engineering. During the entire period of three and a half years of the trial runs and normal service, no man was killed by the high voltage used on the railway. The service on the Valtellina line has shown that in railway operation any security desired can be attained with the high-tension, three-phase equipment, supposing that it is designed properly. After the first period of difficulties the present service is quite satisfactory. In the first year of the regular service considerable trouble was caused by the oil getting to the windings of the motor, but after repairing the damaged insulation and providing for a hermetical closing, no further repairs were necessary; in fact, there has been no occasion during the subsequent period of the last one year and a half to repair the motor windings. This is the best proof for the reliability of three-phase traction motors.

Some years ago a great deal was said in periodicals about troubles which alternating current with earth return may cause in telegraph and telephone circuits. At the opening of the Valtellina line, although the periodicity was not more than fifteen, the railway company was obliged to erect separate insulated return wires for all telegraph and telephone lines running parallel with or near the railway line. Later on different methods were adopted to permit the operation without return wires, and as a matter of fact the telegraph lines along the Valtellina Railway are now working on earth return with entire satisfaction.

An Electric Micrometer.

A new micrometer of great range and accuracy has been described by Mr. P. E. Shaw, before the Royal Society. It consists of a system of six massive levers, the final effect of which is to reduce the movement of a micrometer screw in the ratio of 1,000:1. Contact between the last lever and the object to be measured is made electrically, and the smallest distance which is distinctly measurable is 0.4 $\mu\mu$, a quantity of the order of the size of molecules. The short ends of the levers are fitted with hardened steel plates and with a metal casing which forms the sides of an oil bath. The long ends are fitted with pins which rest on the steel plates, and are partly submerged in the oil to reduce friction and catch dust particles. The electric contact surfaces are of iridio-platinum. The plate in contact with the micrometer screw is of agate. The instrument is enclosed in a felt-covered box, and is suspended by rubber springs from the top of a massive frame, which itself rests on a pile of heavy concrete slabs with rubber cushions at intervals. Contact is discovered by a telephone, the difference of potential being 0.01 volt, which produces a spark not more than 0.1 $\mu\mu$ long. Compared with other micrometers, the instrument is less portable than the optical lever and slower than the microscope, but 500 times more accurate than the latter, and 10 times more accurate than the former or any interference method, besides having a much wider range, amounting to 10,000 units.

Transfer Systems and the Multiple Board in Telephone Exchanges.—II.

(*Concluded.*)

BY ARTHUR V. ABBOTT, C. E.

Fig. 4 shows the cord circuits consisting of an answering plug, a connecting plug, with ringing keys, which enable the operator to ring either subscriber at pleasure. The clearing-out drop, wound for from 500 to 1,000 ohms, is bridged across the line. The cord circuit contains a condenser, *c*, a retardation coil, *r*, and a battery, *b*. When the listening key is pressed the condenser *c* is placed in series in the tip conductor. The object is to provide the so-called busy test. In the non-multiple switchboard each subscriber's line has but one jack always in sight of the operator who serves it,

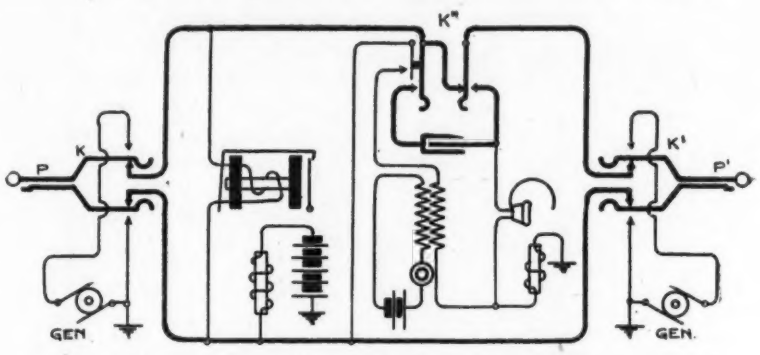


FIG. 4.—CORD CIRCUIT OF SERIES-MULTIPLE BOARD.

consequently the operator can, at a glance, tell whether a line is engaged in conversation or not, by noticing whether its jack contains a plug. In the multiple board each line has many terminals which may not be within the operator's sight, and it is impossible to tell by inspection whether a line is free, so that means must be provided whereby each operator can quickly ascertain whether she can use the jack within her reach without interrupting a prior conversation.

According to Fig. 3 every jack is provided with a ring, *b*. Fig. 4 shows that when two lines are joined by the cord circuit, the battery becomes connected to the ring of the jacks into which the plugs are inserted, and as all the jack rings of each line are in multiple, the insertion of the plugs raises the potential of the rings to that of the battery. One pole of this battery is grounded or connected to a common wire. The center of each operator's receiver is grounded, or similarly connected. If, therefore, an operator touches the tip of the connecting plug to the ring of any jack which is at a higher potential than that of the earth, current will flow through the tip

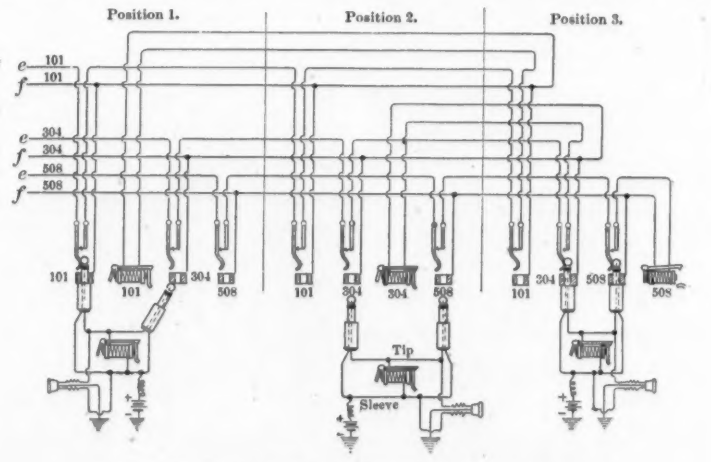


FIG. 5.—BUSY TEST, SERIES-MULTIPLE BOARD.

side of the line and charge the condenser. The charging of this condenser causes the receiver to emit a loud click. If, on the contrary, the tip of the answering plug be touched to the ring of a jack at earth potential, there is no click; hence after an operator at a multiple board receives the subscriber's order, the first operation is that of testing the desired line. The operation is illustrated in Fig. 5. Lines 304 and 508 are shown as engaged in conversation in position 3. In position 1 the operator has inserted the answering plug into line 101, has received an order to connect with line 304,

and touches the tip of the connecting plug to ring 304. Then there will be a flow of current from the positive pole of the test battery in the cord circuit of panel 3, to the ring of jack 304, thence to the ring of jack 304 in panel 1, thence to tip of plug touching this ring to the operator's condenser which is charged, the negative charge set free returning to the negative pole of the test battery. The receiver clicks, indicating that the line is busy. This condenser prevents a continuous flow of current, beyond that necessary to charge the condenser.

The series-multiple switchboards possess a grave objection: One side of the line is extended through the jack contacts in series and as there may be many jacks there will be as many contacts in series. Whenever a plug is introduced, the springs are separated, and frequently a small particle of dust lodges between the contact points. When the plug is withdrawn, the contact fails to close and the line remains open. It is then impossible for the subscriber to call the office, and his only recourse is to hunt up some other telephone station and complain. The branch terminal, or bridging multiple switchboard, was invented to remedy this defect. Fig. 6 shows the circuit of one type of this board, positions 1, 2 and 3 being represented, containing lines 99, 304 and 510. One side of

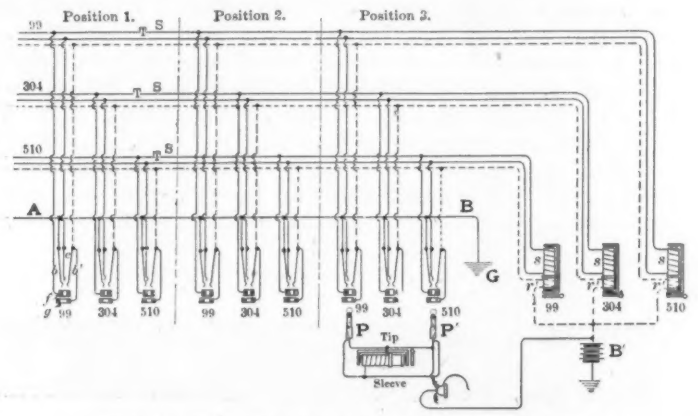


FIG. 6.—CIRCUITS OF BRANCH TERMINAL BOARDS.

each line *t* is connected with the ring *f*. All the *c* springs of each line are in multiple with each other and are connected to tip side *t* of each line, and similarly all of the *f* rings of each line are in parallel with each other and joined to the sleeve, *S*, of the line, hence the name of *Branch Terminal,* or *Bridging Board,* because there are no contacts in the jacks, and consequently subscribers' lines cannot be opened by particles of dirt. Each jack contains two others springs, *b* and b^1 and a ring *g*. All the *b* springs of each line are connected in parallel to a ground, or wire *B*, common to the whole office. Each *g* ring is in series with the b^1 spring of its jack, and all the b^1 springs of each line are connected in parallel to a third wire belonging to

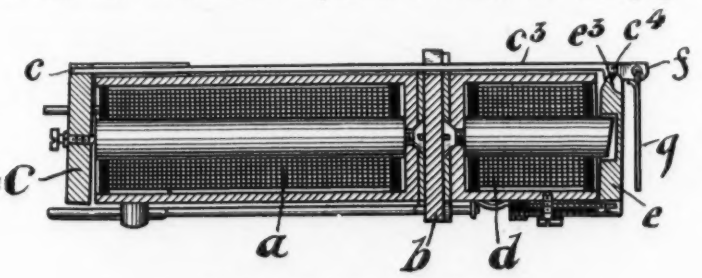


FIG. 7.—SELF-RESTORING DROP.

that line. Therefore this type of board is often called a *"Three-Wire Board."*

The subscriber's signal is a drop having two windings, *s* and *r*. The *s* coil has a resistance of 500 to 1,000 ohms, and is bridged across the line. When the subscriber rings, this winding actuates the drop mechanism and displays the signal; as the drop cannot be cut off by the opening of a jack contact, the signal winding must possess sufficient impedance to avoid shunting the voice current. The resistance of the *r* winding varies from 25 to 50 ohms. One end of this winding of each drop goes to one pole of the office battery B^1. The other end of this winding on each drop is connected to the third wire of the line to which the drop belongs, runs through the board and to the b^1 spring and *g* ring of each jack of the line in question. Fig. 7 shows the mechanism of the drop. When the subscriber rings, the coil *a* is excited, the armature *c* attracted and lever c_3 raised in the usual manner, allowing the shutter *e* to fall by gravity. Instead of being a thin piece of brass, shutter *e* is a thick block of iron having a hole in its center into which the core of the drop protrudes. In front of this shutter is a very light aluminum flap, *g*. As *e* falls *g* is raised, disclosing a signal painted on the front of *e*. Shutter *e* moves but a short distance, so if coil *d* is excited the magnetism developed in the core will retract *e* to its normal position, and allow *g* to drop, concealing the signal. Further, so long as coil *d* is excited *e* is locked in place, and no false signals can be displayed.

Fig. 8 shows an enlarged sectional view of the plug, jack and drop,

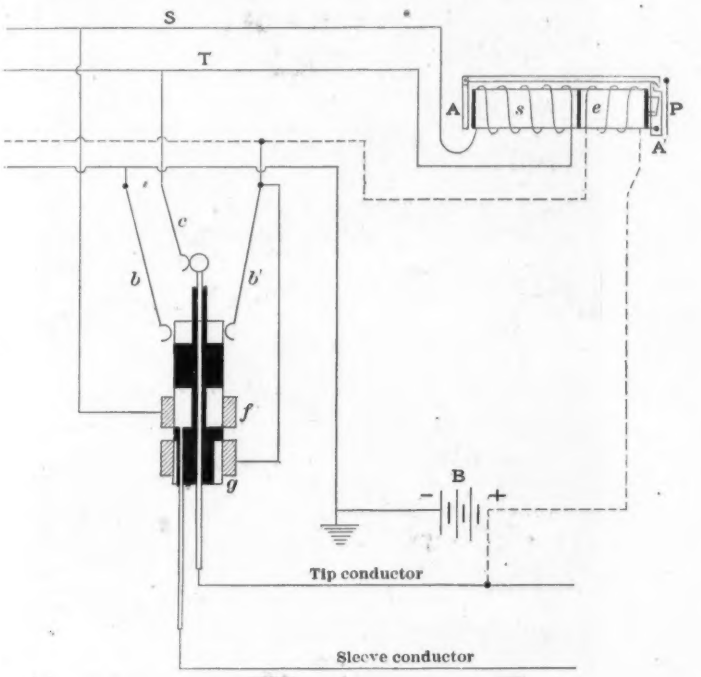


FIG. 8.—SELF-RESTORING DROP.

from which the circuit which restores and locks the drop shutter may be readily traced.

The cord circuit of the branch-terminal switchboard is illustrated in Fig. 12, from which with Figs. 6 and 8 the busy test may be traced. These illustrations show that the tip of each plug and the *g* ring of every jack are normally connected to the same pole of the battery *B*. Hence, if the tip of a plug touches ring *g* of an idle line, no sound will be emitted by the receiver, for both ring and top are at the same potential. When a jack is plugged, springs *b* and b^1 are connected by the jack ring. But spring *b* is grounded; hence ring *g* will be grounded and its potential lowered. The operator is bridged across the line when testing with a grounded centre, hence when the tip of the plug touches a grounded ring, the receiver clicks.

Fig. 9 is a rear view of a branch terminal board, and shows the drop ring at the top of the frame succeeded by the multiple cables, underneath which come the cords and miscellaneous apparatus.

Fig. 10 shows a trunk circuit frequently employed with the branch-terminal system, and a modification employing simpler jacks, having two springs and one ring. The long springs are bridged to one side of the line (the sleeve), the short ones to the other (the tip), forming the talking circuit. The rings are in series with a drop-restoring winding and are connected to the ground. One pole of the office battery goes to the plug ring, the other to the ground, so that as soon as the operator inserts an answering plug, the restoring winding is excited, and the drop is locked. Normally, the rings are grounded, and the plug tip is neutral. A busy line has a battery on the ring, and the test is made as usual with a split receiver. Each cord is supplied with an order-wire key, *K*, whereby the operator may bridge her telephone upon the order-wire which ends in the talking set of the *B* operator at the incoming trunk office. The order-wire is also supplied with a self-restoring drop, *D*, which may be operated by the key, *K"*, so that at night or when the *B* operator is not near her receiver, the *A* operator may signal.

The trunk line is split into three parts by means of two repeating coils, *R* and R^1, partly to render the line quiet when connected to grounded subscribers and partly for ease in giving a disconnect signal by furnishing what has been termed a *"phantom circuit."* From

the trunk-jack ring, *B*, a conductor, 1, runs to the center, 2, of the trunk line side of the repeating coil in the originating office, while from the center, 3, of the trunk-line side of the repeating coil in the incoming trunk office, a conductor, 4, passes to a signal, 5, and to ground. After the *B* operator has assigned the trunk to the *A* operator, the *A* operator inserts the connecting plug into the trunk-

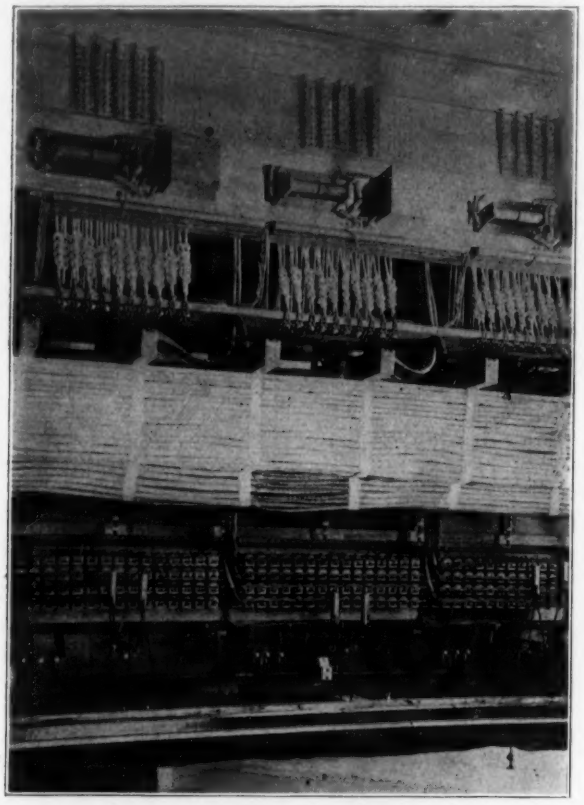


FIG. 9.—REAR VIEW OF BRANCH TERMINAL BOARD.

line jack. This connects battery and the ring, whence current flows to the center of the trunk-line side of the repeating coil, divides, flows equally over both sides of the trunk-line to the center of the coil in the incoming trunk office, then to the signal, to ground and back to the originating office. The signal is the largest type (see Fig. 11) consisting of an electromagnet, furnished with pivotted armature. When the magnet is excited, the armature is attracted and a conspicuously colored disc is made visible. So long as the connecting plug is in the trunk-line jack at the originating office, this busy signal will be displayed, because battery current flows over the trunk circuit. But as the current splits equally over both sides, there is no interference. When the clearing-out drop in the *A* office indicates that the subscribers have finished, the *A* operator removes both plugs, and the target signal disappears, indicating to the *B* operator that the trunk circuit is free.

The use of the multiple board produced a marked effect in decreasing cost of operation and in improving the service, so that telephony developed with great rapidity, producing a tendency to concentrate a large number of subscribers in a single office. There is, however, a limit to such concentration, because as soon as the number of jacks become so great as to make it impractical to place all lines within the reach of every operator, the multiple system fails, and some transfer method becomes necessary. To carry the multiple principle as far as possible, the greatest ingenuity has been exercised in devising jacks to occupy the smallest space, so that a very large number can be concentrated in front of the operator. Figs. 13, 14 and 15 are examples of modern methods of jack construction. Fig. 15 shows two-point jacks, designed for multiple switchboards, mounted in strips of 20. The strip is of hard rubber, drilled and slotted to receive the rings and springs, which are respectively of brass and hard German silver. Such jacks are mounted on ½-in. or ⅜-in. centers. Fig. 13 shows four-point jacks of the cut-off type having platinum-contact, German silver springs. The illustrations show the mounting used for answering jacks, ready for association with the line signal jacks. Fig. 14 is a five-point jack, the economy of design having been carried far enough to allow these to be arranged upon ½-in. centers.

The quantity of equipment of a multiple switchboard depends upon two different factors. The number of answering jacks and signals depends solely upon the number of lines, while the number of multiple jacks depends upon the number of operators, which varies as the amount of traffic. For example, assume an exchange of 1,000 lines in which the average rate of originating calls is 6 per day, and suppose that each operator can answer 1,000 calls per day. As there are 1,000 lines there must be 1,000 answering jacks and signals. The total number of originating calls per day will be 6,000, and, if each operator answers 1,000 calls, 6 operators will be needed. Suppose that the originating calls average 16 per day instead of 6, there will then be 16,000 calls per day, and, at the same rate, 16 operators will be required. Evidently the number of line signals and answering jacks must be increased to place each line within the reach of 16 operators instead of 6.

The modern switchboard consists of a substantial iron frame,

FIG. 11.—TARGET SIGNALS.

which is sub-divided into panels into which the apparatus is placed. It is customary to design the frame so that a full multiple will occupy either 5, 6 or 7 panels, depending upon the size and the style of the jack, and hence switchboards are frequently designated 5, 6 or 7 panel boards, indicating thereby the number of panels which are required for one multiple. Practice has settled to the idea of arranging the multiple to cover the space occupied by three positions, so that the middle operator sits in front of the second third of the multiple, has the first third on her left and the third third on her right. Therefore, in order that all operators shall have access to every line it is essential to provide an extra one third section of multiple jacks for each operator at the ends of the switchboard. To determine the number of multiple jacks required it is necessary to estimate the number of operators. This number divided by three give the total number of complete multiples; to this add two-thirds of a multiple to care for the end sections; the number of lines multiplied by the number of multiples, plus two-thirds of a multiple, will give the total number of multiple jacks. For incoming trunk service, where operators work at higher rates of speed, it is sometimes customary to use a two-operator multiple, in order that there shall be less interference between adjacent operators.

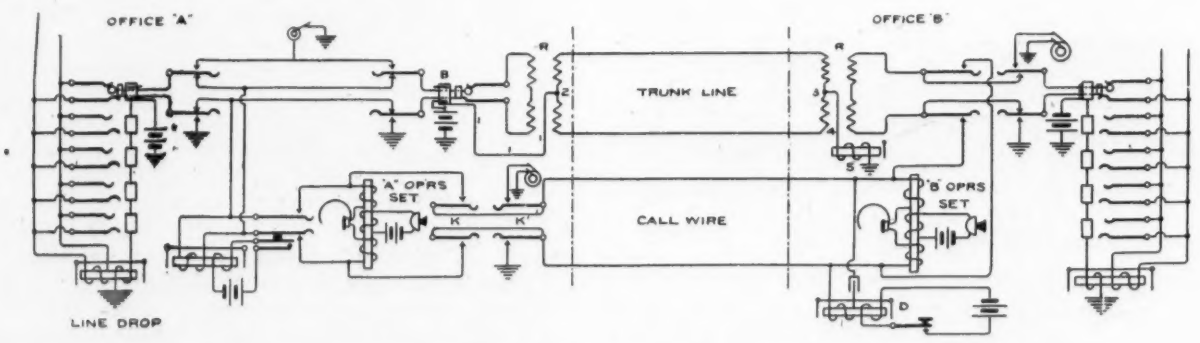


FIG. 10.—TRUNK LINE, BRANCH TERMINAL BOARD.

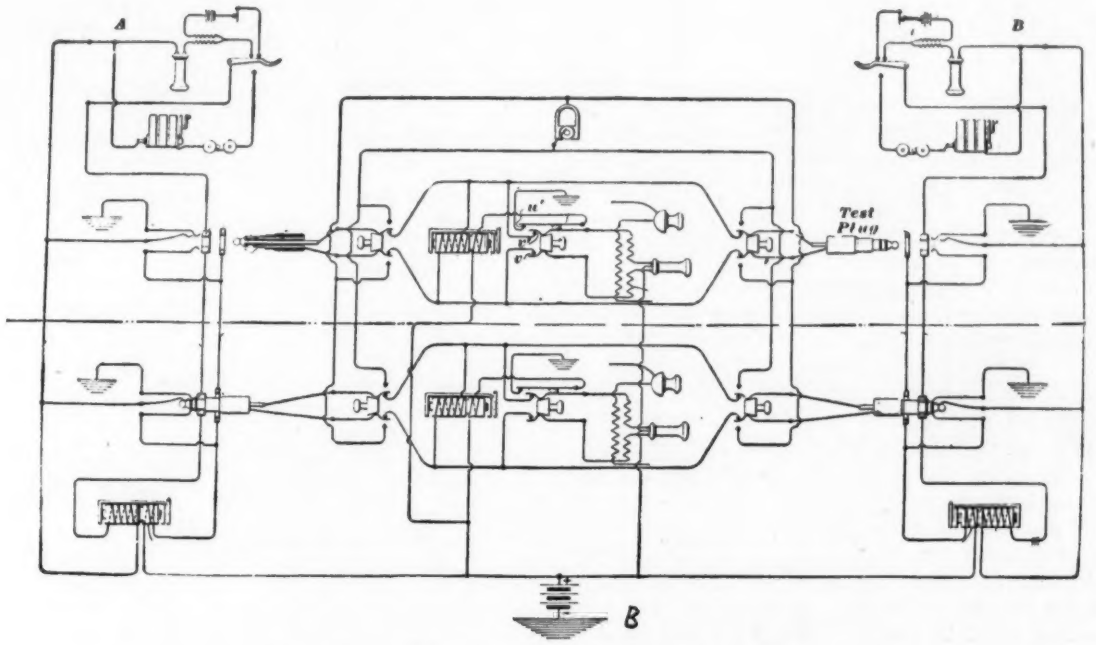


FIG. 12.—CORD CIRCUIT, BRANCH TERMINAL BOARD.

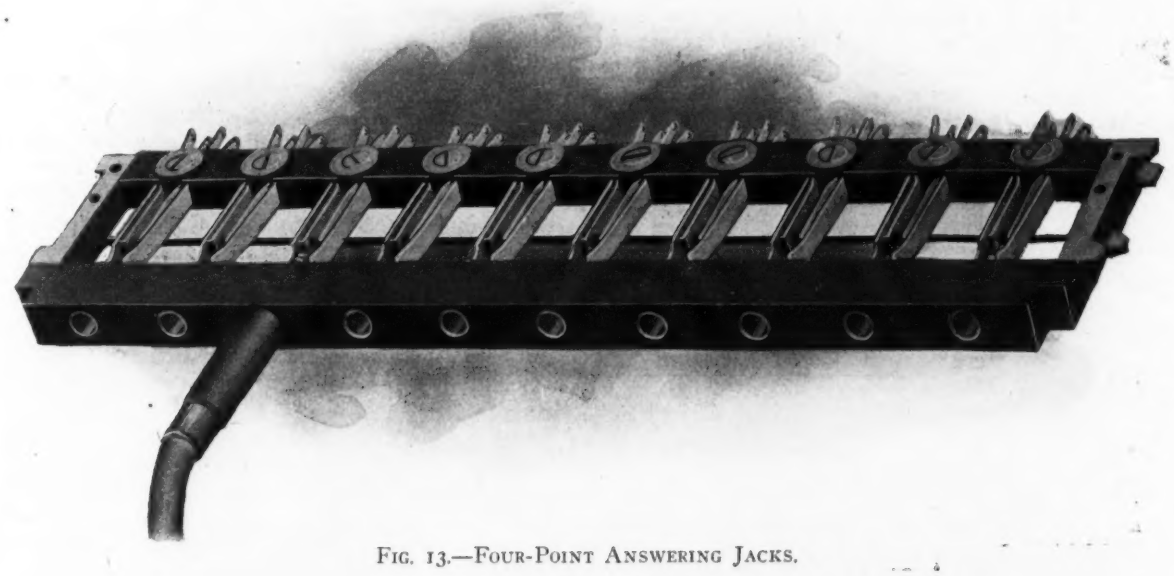


FIG. 13.—FOUR-POINT ANSWERING JACKS.

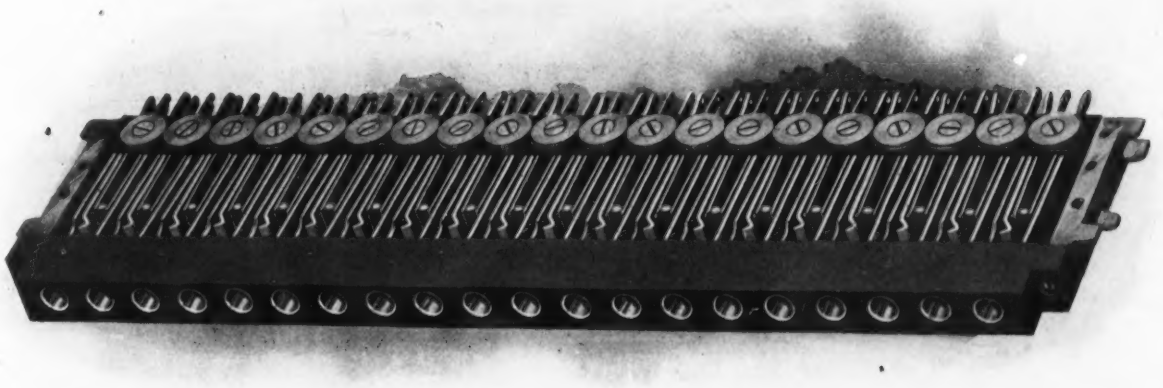


FIG. 14.—FIVE-POINT MULTIPLE JACKS.

TELEPHONE TRANSFER SYSTEMS AND THE MULTIPLE BOARD.

The chief objection to the multiple board is the expense of the large number of multiple jacks which are required in large offices. To economize, all sorts of transfer systems have from time to time been devised. In some instances the board has been cut into two parts, half of the subscribers being located in one section and half in the other. In each section there is provided a subscriber's answering jack and signal, and the sub-station is so arranged that the subscriber can signal either section at pleasure. By this means the number of multiple jacks is reduced, but twice as many answering jacks and signals are required, and experience has shown that subscribers are so prone to signal the wrong section of the board as to make this method of doubtful expediency.

Experience has shown that *B* operators can handle more calls per day than *A* operators, so the expedient has been tried of placing the subscribers' terminals before an *A* operator who shall answer, take the order and transfer the call to *B* operators placed in front of a multiple. This method produces an economy in cost of installation, but it is open to the disadvantages of any transfer system. It has been usually argued that since a transfer system requires the co-operation of two operators, the service is more expensive, but it is found that the office management is the more important factor in regulating the expense than the co-operation of two operators versus the interest and depreciation on the cost of multiple jacks, for careful statistics show that the expenses of handling calls in offices of approximately the same size, whether on a multiple board or a divided board, are closely the same.

The business of a telephone exchange varies from minute to minute, and if a method could be devised whereby the load on the answering operators could be equalized, enabling all to work at a steadier rate, much more business could be accomplished more cheaply. Of the many transfer systems that have been suggested for the solution of this problem, most notable is the so-called *"Sabin Express System."* The subscriber's signal is placed before an operator, and is also furnished with trunk lines extending to the other operators. These trunk lines are equipped with busy signals to indicate whether an operator is or is not engaged. When the subscriber's signal is displayed, the operator in front of whom it appears transfers the line to any disengaged operator. The first operator is often termed a *Y* operator, the second an *A* operator, because the latter takes the subscriber's order and by means of a trunk line extends the subscriber's line to a *B* operator in front of whom the jack of the desired subscriber appears. Then the last operator completes the connection. Apparently the operating load should be steadied, more work accomplished at cheaper rates and the cost of the multiple jacks saved. But under operating conditions, neither this nor any other transfer system has succeeded in competition with the multiple. This fact is doubtless partially due

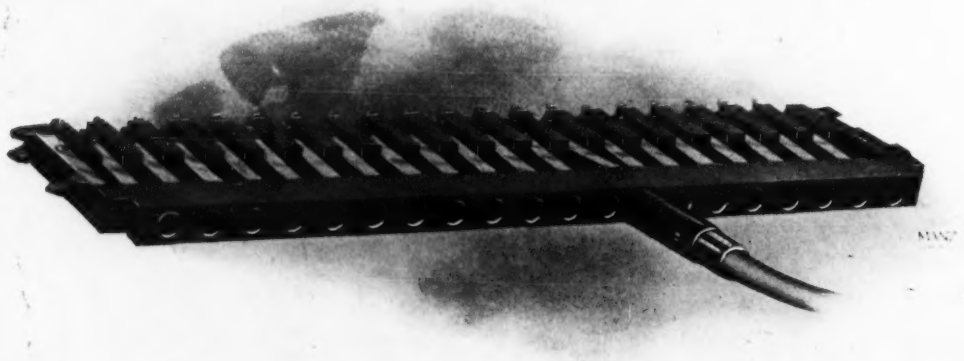


FIG. 15.—TWO-POINT MULTIPLE JACK.

to a reduction in the cost of multiple jacks. Formerly jacks and cable were rated at $1 to $1.25 each, whereas now the price has fallen to 25 cents. This reduction of cost has reduced installation expense and consequently stimulated the development of multiple switchboards. In fact, the improvement and perfection of the multiple board has been in recent years one of the favorite branches with inventive workers in the telephone field, and a large proportion of the patents issued in telephony have been devoted to the modern multiple board. It is difficult to take any issue of the *Patent Office Gazette* and not find in it some patents devoted to the multiple board, not only as to circuits, but as to construction and concentration.

New Telephone Patents

CIRCUIT SYSTEMS FOR SWITCHBOARDS.

Three patents for different common battery switchboard circuit systems have been issued to Mr. W. W. Dean, these patents all being assigned to the Kellogg Switchboard and Supply Company.

All three are worked out upon the two-wire basis, i. e., there are but two joints to the various jacks. Fig. 1 shows one of the sys-

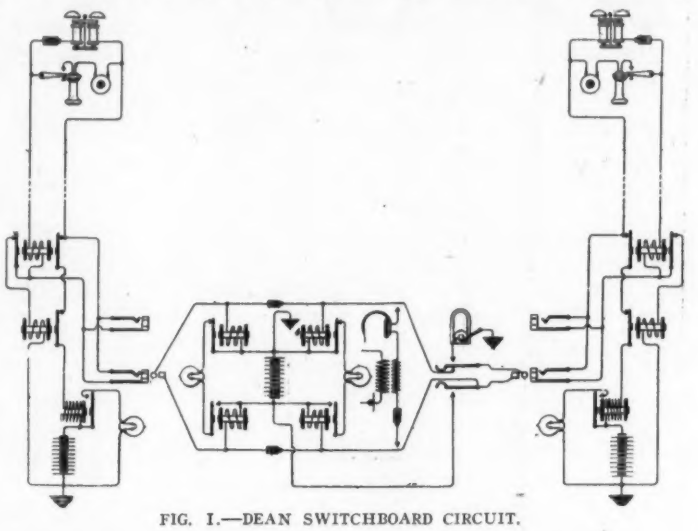


FIG. 1.—DEAN SWITCHBOARD CIRCUIT.

tems. It will be seen that the line relay controlling the lamp must be of high resistance. Then while it operates upon the closing of the circuit at the subscriber's station, yet insufficient current flows to operate the intermediate and cut off relay. When an operator answers, a circuit may be traced through the plug sleeve and cut-off relay, to the subscriber and back through the plug tip. The cut-off relay cuts off both line and intermediate relays. Should the subscriber hang up, the intermediate relay will operate to cut the line relay circuit, the current supply for this relay coming from the cord circuit over the sleeve of the plug. The cord circuit is one often employed with this type of system. It will be noted that a busy test potential is put upon the test ring of the jack as soon as a call lamp is lighted, as this ring is connected to the line relay circuit between the cut-off relay and line relays.

In the other two systems, one side of each line is permanently connected to the grounded pole of the battery through one coil of a double-wound relay. The other pole of the battery is similarly connected to the other side of the line, but in addition it is connected to both strands of the cord pairs. The operation may be readily traced. In this system the cut-off relay being in the battery circuit must be shunted as herein shown, or must be differential as described in the third patent.

VARIOUS APPLIANCES.

Mr. E. P. Baird, of Evanston, Ill., has invented a transmitter arm of the usual adjustable type, in which the clamping screw which usually appears at the base is done away with. The usual wings or ears of the base piece are recessed internally to receive spring washers placed upon both sides of the arm proper. These washers have a stud at the center which engages recesses in the arm. The spring washers thus serve by their friction not only to clamp the arm in any position desired, but also serve as pivots.

A hand microphone for the use of the deaf has been patented by E. W. Schneider, of New York City, he having assigned his patent to the Mears Ear Phone Company. The telephone or receiver part is of the watchcase type and is mounted upon a hollow handle within which the small dry cells for the transmitter are placed.

Mica fuses, so called, are now in general use. These consist of a small piece of mica sheet, carrying copper terminals between which a small piece of fuse wire is stretched. The mica serves to protect the minute fuses required in telephony. As a still further protection, Mr. F. G. Jones, of Chicago, has arranged the fuse between two micae, the terminal serving to clamp the whole firmly together.

Mr. F. B. Cook has made further improvements in the self-soldering sneak current protectors recently patented. These are of a type in which the grounding springs are held by teeth in the thermal device. This latter becoming heated, rotates under the pressure of the springs and these latter are released and ground the circuits. The present improvements involve a special shaping of the springs such that a test plug may be inserted and withdrawn without disturbing the normal relations of the apparatus.

A very different type of protector is that patented by M. L. Smith,

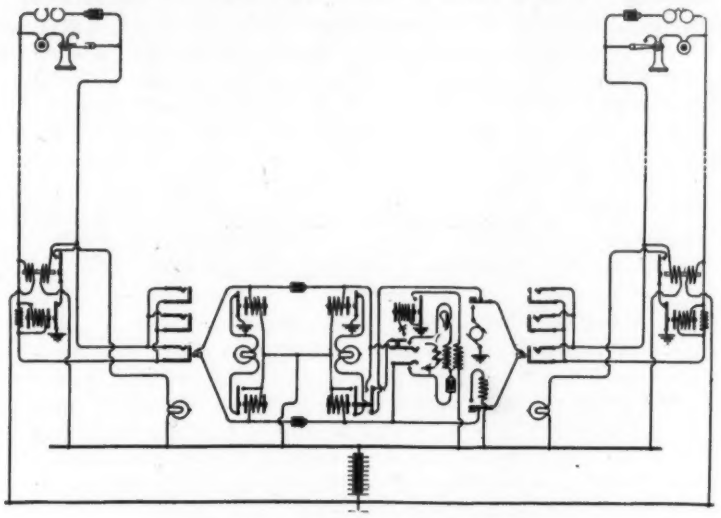


FIG. 2.—DEAN SWITCHBOARD CIRCUIT.

of Rutledge, Mo. This is an apparatus for opening a line or lines at the subscriber's premises. A lever serves to pull apart contact springs included in the line and to thrust into the opening between them a sheet of insulating material.

INTERCOMMUNICATING SWITCH.

A self-restoring intercommunicating switch is described in a patent granted to Messrs. A. S. De Veau, of New York, and Charles Auth, of Brooklyn. The switching is done by buttons which become locked into position until the act of restoring the receiver restores all to normal, by shifting the latch plate.

TELEPHONE SWITCHBOARD.

It is a well-recognized fact that a telephone switchboard is difficult to keep free from accumulations of dust or dirt. To overcome the ill effects of dirt, Mr. M. C. Burt, of Chicago, arranges all his wiring within a hollow cylinder, through which he proposes to blow a stream of air to blow out dust.

LOCK-OUT SYSTEM.

A patent has been issued to T. Matheny and R. C. M. Hastings, of Athens, O., with which no connections of the various telephones to the talking line may be made without the assistance of the exchange. Thus a party desiring to talk must send in his station number. Unfortunately this must be done on a third or signal wire, which at once prohibits the general use of the system.

LETTERS TO THE EDITORS.

Diagrams of Railway Passenger Travel.

To the Editors of Electrical World and Engineer:

SIRS:—In an editorial which appeared in the issue of the ELECTRICAL WORLD AND ENGINEER for February 18, 1905, attention is drawn

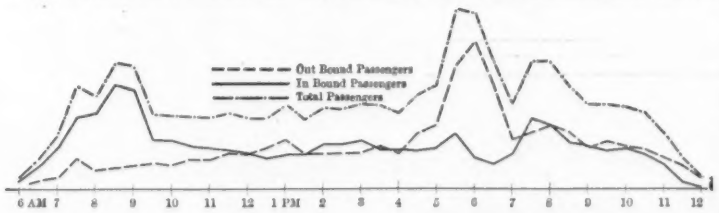


FIG. 1.—CURVES SHOWING PASSENGERS CARRIED ON TUESDAY.

to the value of load diagrams. It is believed that the accompanying diagrams present some features of interest. These diagrams do not indicate the load on the station, but show the number of passengers traveling upon the Brisbane tramway at different hours of the day. The diagram of Fig. 1 shows the number of passengers actually on the cars each half-hour from 6 a. m. until 12 midnight. It represents the average of counts taken on two separate Tuesdays. There are three curves, one of which shows the out-

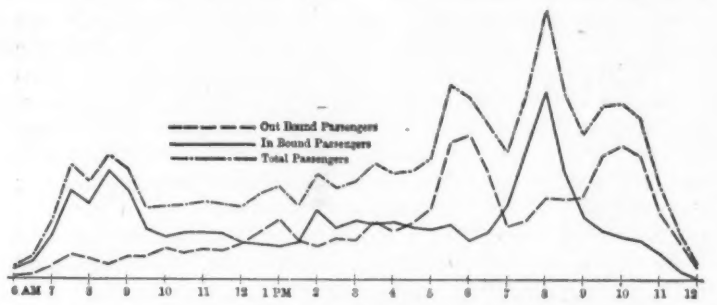


FIG. 2.—CURVES SHOWING PASSENGERS CARRIED ON FRIDAY.

bound passengers; the second, inbound passengers; and the third, total passengers. This and the diagram of Fig. 2 were obtained by actually counting the passengers on the cars every half-hour during the day. The conductors were supplied with cards suitably ruled, and the diagram was made up from the returns.

The curves of Fig. 2 show the average of the number of passengers on two Fridays. The difference between the shape of the diagram of Fig. 1 and that of Fig. 2 is quite marked. There is in force

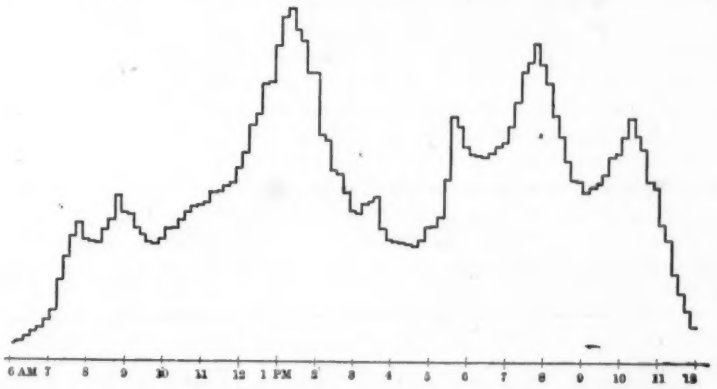


FIG. 3.—CURVE SHOWING RECEIPTS FROM PASSENGERS ON SATURDAY.

at this place a law which requires that all stores be closed at six o'clock every night except Friday, which is recognized as the laboring man's shopping night. The diagram of Fig. 3 represents the receipts by periods of ten minutes for a Saturday. The data for this curve were obtained from the conductors' way bills.

BRISBANE, AUSTRALIA. J. S. BADGER.

Measurement of High Electrical Pressures.

To the Editors of Electrical World and Engineer:

SIRS:—In the issue of your journal under date of July 8 there appeared a report of part of the discussion on my A. I. E. E. paper on "Methods of Measurement of High Electrical Pressures," and an editorial on the same subject. As these articles both lean very strongly on one side of the question I trust I may be allowed sufficient space to indicate some facts which, from the standpoint of the practical operator, point very decidedly to the other.

First in reply to the criticisms of the editorial. It was stated that one weak point in the static meter described by me was in that the law of the deflectors was not simple enough to permit of one observation and then a calculation of the rest of the scale. This same criticism is true of nearly every alternating-current meter in use, including the spark gap, and while perhaps an inconvenience, is so trivial in comparison to the difficulties overcome as to be negligible.

The criticism that the meter reads square root of mean square values instead of maximum ones is rather odd, in view of the fact that all alternating-current meters read the same and there seems little possibility of getting any other kind. At present, aside from oscillographs and instruments of that type, there are no meters that indicate maximum values. These, under commercial testing conditions, are not to be considered, on account of excessive cost, diffi-

culty of manipulation, expense of auxiliaries and errors involved in use of same.

The statement that the maximum voltage "ought to count" in insulation testing is certainly true—the only question is, How can that maximum value be most accurately determined? Dr. Steinmetz looks to the spark gap as the best way of determining the maximum values, and even goes so far as to state that "if the instruments and spark gaps do not agree that the spark gap is correct," and the spark gap must be considered the ultimate "court of appeals." The maximum voltage that should count in an insulation test is the one that regularly recurs each alternation. The one the spark gap indicates when working under its best conditions is the maximum one of a great number that occur during its application. This maximum one may be 15 per cent or 20 per cent higher than the normal maximum values, caused by some momentary surge on the system, and the tester is fooled by that amount. Yet this one high value, which the meters would ignore, would cause no damage to the insulation. Mr. W. L. R. Emmet, before the A. I. E. E. at its Buffalo convention in 1901, called attention to the ability of solid insulation to stand momentary excess voltage while air would break down.

Mr. Fisher has noticed that differences in the size of the points of needles selected from the same pack cause variations of 15 per cent or 20 per cent in the voltages required for a given gap. His tests were made at about 15,000 or 20,000 volts. I have noticed variations of as much as 70 per cent in the voltage for a certain gap due to a loose contact. Current-limiting devices, such as condensers and resistances, change the jump values very decidedly, though a voltmeter on the line shows no change.

In addition to all the above and much more that could be added, which are simply errors that are likely to creep in and cause a mistake in the value of the pressure that is supposed to have been applied, the spark gap is a positive menace to the apparatus under test, as well as the testing apparatus. This is particularly true of transformers, high-voltage generators and motors, as the change in the distribution of the electro-static charge may cause strains between turns and develop a trouble which would otherwise not have occurred. The danger is less when line insulators, cables and apparatus without inductance are under test.

My experience in high-pressure measurements leads me to believe that for accurate, consistent results this type of meter is far superior to any other with which I am acquainted.

In closing I wish to state that I am in perfect agreement with you in the statement that there is a demand for an instrument which will indicate maximum values—and no one will welcome its advent more than I—but the spark gap is not it. I am also in agreement with your closing remarks in the editorial of July 1st, "that a simple and reliable voltmeter for very high tension is much to be desired," and I believe the one proposed in my paper, which after six months' service has not developed any serious defects, will be found very useful.

I believe the views expressed above regarding spark gaps are quite general among a large majority of the engineers whose experience qualifies them to judge of this question. The discussion at Asheville, of which a part only was given in your report, indicated that such a belief exists.

PITTSBURG, PA. S. M. KINTNER.

The Double Trolley in Cuba.

To the Editors of Electrical World and Engineer:

SIRS:—In reference to your editorial in your issue of July 8 regarding the double-trolley system, you have been misinformed regarding the use of double trolley on the lines of this company now under construction in the vicinity of the city of Havana. While we will use two trolley wires outside of the city, they will be used in a way common to a large number of interurban roads in the States; the single-trolley method being used, with track return.

We were compelled to use the double-trolley system in Havana proper by the United States military engineers, due to their belief that this was the only method of avoiding the possibility of the danger of corrosion of the existing water works system.

In general our road will be along the lines of the usual interurban road in the States, except where changes are made necessary by local conditions.

HAVANA, CUBA. A. W. K. BILLINGS,
Chief Engineer Havana Central Railroad.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Cascade Rotary Converter.—An illustrated description of the "cascade rotary converter" of the Nancy General Electric Company. This machine is intended to combine the advantages of the motor-generator and of the rotary converter. It is self starting and when started it runs up to synchronism. The synchronizing torque is so strong that it is almost impossible to get the machine out of step. The direct-current side of the machine may be adjusted to suit any case. The voltage can be regulated by means of a rheostat in the shunt-exciting circuit. The machine may be connected to a 3-wire system and in this case acts as an automatic balancer. Any reversal of polarity is impossible. The efficiency is more than 2 per cent higher than that of a motor-generator of the same capacity and is about equal to that of a rotary converter with its transformer. Employed as a generator of alternating current, its regulation is excellent even with a low-power factor and its price is lower than that of an ordinary motor-generator of the same capacity. The machine consists in principle of an induction motor and a converter, the axles of both machines being rigidly coupled. The rotor windings of the induction motor and of the converter are connected in cascade, as shown in Fig. 1. It may first be assumed that the motor and converter have the same number of poles—two poles in this case—and that the rotor and the converter armature revolve with an angular speed corresponding to half the frequency of the primary alternating current. Under these conditions the revolving field induced in the rotor by the primary re-

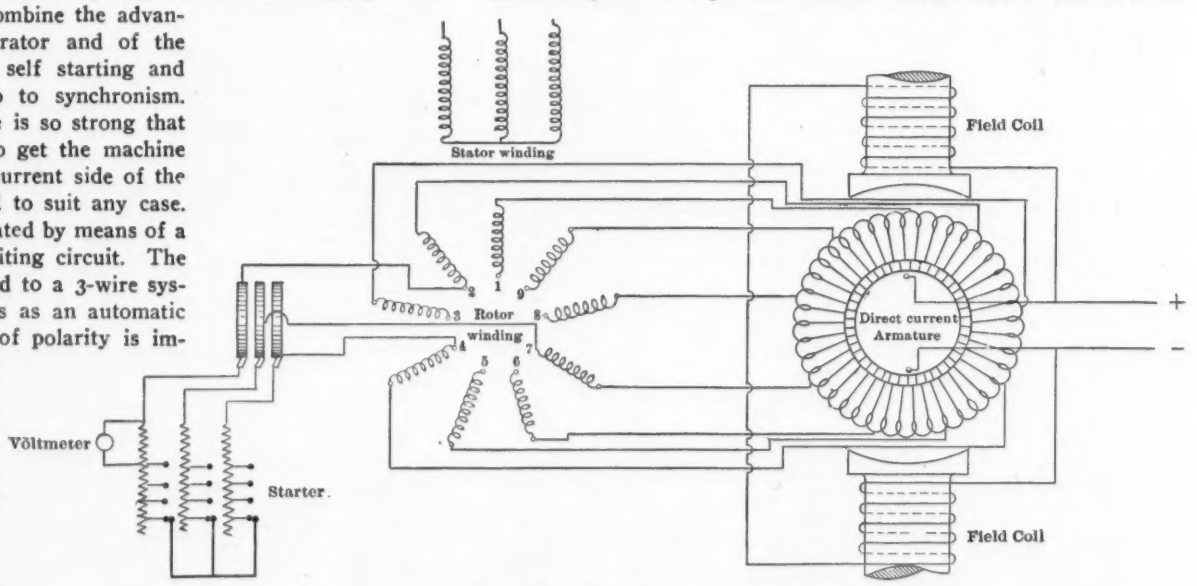


FIG. 1.—ROTARY CONVERTER.

volves with respect to the rotor with half the frequency of the supply current, so that there is induced in the rotor winding an alternating e.m.f., the frequency of which is equal to one-half the frequency of the primary circuit. This e.m.f. creates a current in the armature winding of the converter so that there is produced in the armature a revolving field which revolves with respect to the axle with a speed corresponding to half the frequency of the supply current, i. e., with half the speed of the axle. Now the armature of the converter is connected with the rotor in such a way that the revolving field revolves in a direction opposite to that of the axle. It follows therefore that this revolving field does not move in space and that therefore the machine works at this speed as a synchronous motor. Since the induction motor revolves with the speed corresponding to half the frequency of the primary current, half of the electric power furnished to the induction motor is transformed into mechanical power and is transmitted through the axle mechanically to the converter, while the other half is transmitted electrically to the rotor windings and through these to the armature of the converter. Under these conditions the induction motor works half as motor and half as transformer, while the converter works half as direct-current generator and half as a converter. If the induction motor and the converter have not the same number of poles the machine revolves with a different speed depending on the ratio of the number of poles of the motor and of the converter, and the amounts of power transformed in the motor into mechanical power and electrical power are proportional to the number of poles of the motor and of the converter respectively. Consequently, the number of poles of the direct-current machine can be chosen so as to realize a great saving of material. At starting, a high-tension alternating current passes through the stator and induces currents in the rotor winding. At starting only three of the nine windings of the rotor are utilized, as shown in Fig. 1. They are connected by means of slip rings and brushes to an external non-inductive rheostat. This resistance is gradually cut out while the speed of the machine runs up. The other terminals of the three phase-windings are permanently connected with three points of the armature of the converter. The direct-current supply circuit of the converter is of course open during starting. The machine starts as an ordinary polyphase motor. At the same time the direct-current side excites its field. As indicated in Fig. 1, the resistance connected to the rotor cannot be cut out completely, since the rotor can attain half-synchronism only. While resistance is being cut out the amplitude of the oscillations of the voltmeter diminishes. A few seconds after the last notch on the controller is reached the voltmeter falls to zero, indicating that the machine runs at half synchronism. Now the slip rings are short-circuited and the points 1, 2, 3,.....9 of the rotor windings are connected together so that the nine phase-windings of the rotor are now in service. In the transformation of alternating currents into direct current, the total drop of voltage between full load and no load may be regulated between 3 and 15 per cent. In general in transforming from alternating into direct current the voltage drop is 3 to 5 per cent with a power factor equal to unity and 5 to 12 per cent with a power factor of 0.8. If the converter shall supply a 3-wire distributing net work it is arranged as shown in Fig.

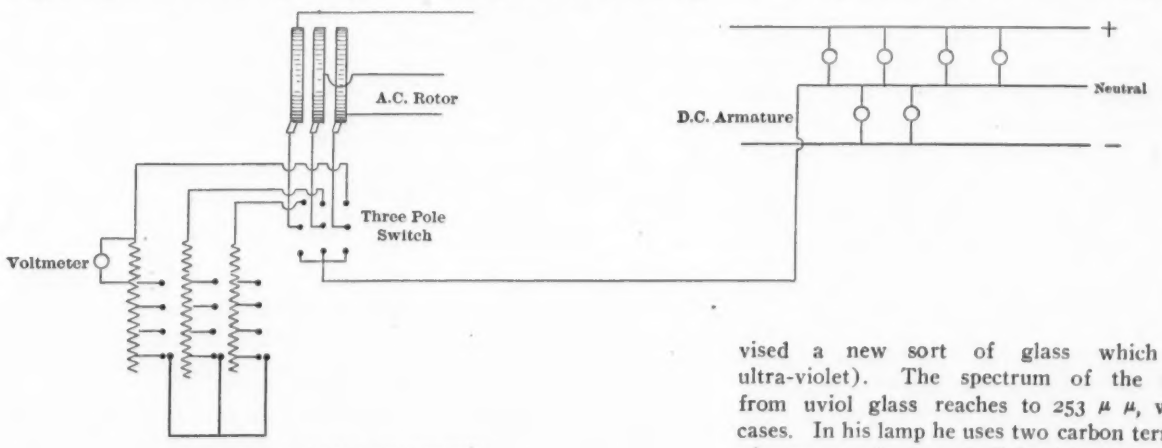


FIG. 2.—ROTARY CONVERTERS.

2. The converter operates as a balancer and as the generator and the balance is so perfect that if one of the two halves is completely loaded and the other half is unloaded the difference in the voltages is not more than 3 per cent.—*L'Industrie Elec.*, July 10.

Commutation Poles.—BRESLAUER.—A long illustrated article on direct-current machines with commutation poles. The author first discusses the principle and gives the results of tests which he has made. He then discusses the best dimensions of the commutation poles. These poles should not be made too thick in their tangential dimensions. Even when the thickness of the poles was decreased to 40 per cent of the slot pitch with five segments per slot good results were obtained, while the axial breadth was two-thirds of the armature breadth. As a material for the commutating poles solid iron may be used, while the length of the air gap is determined by mechanical considerations. For the ampere-turns required for the auxiliary poles, he found values which are between 1.2 and 1.4 times the armature ampere-turns. This, of course, increases the cost of the machine. On the other hand there is a saving in the copper of the main poles since the air-gap may be reduced as far as is possible on account of mechanical considerations; further, in view of good commutation and small field distortion, there is no longer any necessity of high saturation of the teeth. A further saving is accomplished by reduction of the dimensions of the commutator. He concludes that a machine properly designed with commutation poles will cost only little, if at all, more than an ordinary dynamo. Since good commutation is taken care of, it is only necessary to take into consideration the limit due to the heating of the machine; if perfect ventilation is provided, then it is only necessary to take the efficiency of the machine into consideration. The author thinks that this involves the possibility of another essential reduction of the cost of direct-current machines.—*Elek. Zeit.*, July 13.

Inverted Rotary Converter.—CLINTON.—If a specially excited rotary converter be driven at a constant speed with the rings and brushes on open circuit, the ratios of the maximum alternating e.m.f. between the rings to the e.m.f. over the brushes is given by a well-known expression. If, however, the converter be driven by current supplied to either side, the other side being on open circuit, then a correction on the above value becomes necessary owing to ohmic drop in the armature conductors. The author treats this problem mathematically and finds the following numerical results. The value m in the table is the ratio of the voltage on the brushes to the ohmic drop from brush to brush.

	Corrected Ratios (as percentages)				
Type of Machine.	$m = 10$.	$m = 50$.	$m = 200$.	$m = 500$.	Uncorrected Ratio as Percentages.
Single-phase	67.13	69.61	70.42	70.58	70.72
Three-phase	56.70	60.18	60.95	61.10	61.24
Four-phase	46.04	49.11	49.75	49.905	50.00
Six-phase	32.46	34.73	35.19	35.29	35.25
Twelve-phase	15.60	17.97	18.21	18.26	18.30

The percentage corrections due to voltage drop on the unloaded machine is practically independent of the number of phases if the value of m is of the order usually found in good design.—*Phil. Mag.*, July.

Magnetic Pull.—NIETHAMMER.—An article giving several formulas for calculating the magnetic pull in dynamos and motors, due to errors in symmetry of construction.—*Zeit. f. Elek.* (Vienna), July 9.

LIGHTS AND LIGHTING.

Mercury Arc Lamp for Ultraviolet Rays.—AXMANN.—The mercury arc is very rich in ultra-violet rays, but if they are to be made use of, ordinary glass cannot be used, since it absorbs these rays. Heraeus has constructed a mercury arc lamp from fused quartz giving ultra-violet rays of 220 $\mu\mu$ wave length. Fused quartz apparatus, however, is expensive. Schott has devised a new sort of glass which he calls Uviol, from ultra-violet). The spectrum of the mercury are lamp made from uviol glass reaches to 253 $\mu\mu$, which is sufficient in most cases. In his lamp he uses two carbon terminals with a small quanity of mercury; the lamp is lighted by means of tilting. Since both terminals are of carbon they may be exchanged at will, but it is necessary to have the negative terminal of the lamp at the lower level, so that it is always covered with mercury, as otherwise it would burn out. The following applications of ultraviolet rays are mentioned. Photochemical effects, generation of ozone, ionization, fluorescence and especially applications in medicine.—*Elek. Zeit.*, July 6.—A longer illustrated article by Schott on the same subject is published in *Zeit. f. Beleucht.*, June 20.

Ratio Between the Mean Spherical and the Mean Horizontal Candle-Power of Incandescent Lamps.—FLEMING.—A (British) Phys. Soc. paper with reference to the experimental result obtained by Dyke as to the ratio of the m.s.c.p. of incandescent electric lamps to the m.h.c.p., taken when the lamp was rotating round a vertical axis. In the case of 9 different types of electric incandescent lamps, this ratio was found to be a number near 0.78. The present author shows mathematically why this must be so.—Lond. *Elec.*, June 23.

POWER.

Power Distribution System.—An illustrated article on the Clyde Valley electric power system. The district to be supplied comprises about 750 square miles and contains the most important manufacturing and coal-producing district in Scotland. There are two generating stations at Yoker and Motherwell, while 10 sub-stations are at present installed in the Motherwell district and 3 in the Yoker district. These 2 districts will not at present be connected in any way, although they may be in the future. Each power plant contains 2 Westinghouse turbo-generators, running at 1,500 rev. per min. The turbines are of the double-flow pattern, steam entering at the centre and exhausting at both ends, and each contains 20,000 blades. Each of the turbines is directly connected to a 2,000-kw, 11,000-volt, three-phase, 25-cycle generator of the revolving-field type.—Lond. *Elec.*, June 23. (See this issue E. W. & E. for full details.)

Oil as Fuel.—CHAMBERLIN.—A very long illustrated article on the North Beach power station of the United Railroads of San Francisco, which was put in operation during the summer of 1903. The capacity is 6,600 hp. Since the start, oil fuel has been used with much success. "It is preferable to coal on account of its cheapness both in regards to first cost and handling, in ease of operation, in cleanliness and in heating capacity." The oil consumption is at the rate of 0.28 gal. or 2.24 pounds per kw-hour.—*Power*, August.

Electric Winding Machines.—HABETS.—The conclusion of his paper, the first part of which was abstracted in the Digest last week. He describes several electrically-driven winding machines installed in European mines. The final conclusion is that the electric-haulage machine, even if it is not more economical than the best steam-driven machine, is certainly not more expensive. The greater facility and safety with which it can be manipulated, the smoothness with which it works and its much greater flexibility will often make it preferable to the steam-driven machine, even in the case where transmission of energy is not required. There can be no hesitation in the choice between the two systems, when the power has to be transmitted from a distance, or, where the production of energy can be centralized at one power station.—Lond. *Eng'ing.*, July 7.

Electric Power in Mexico.—BLACKWELL.—Coal costs at ports on the Gulf of Mexico about $6 (in gold) per ton, while in the interior the cost of transportation increases the price per ton by from $10 to $20. The country is mountainous and, though no large rivers exist, high waterfalls make many developments possible. The author gives a review of water-power developments in Mexico. The latest plant now under construction is that of the Mexican Light & Power Company, at Necaxa. This will be one of the largest plants in the world and in addition will deliver power over a greater distance than has yet been undertaken by any other installation. There will be two plants, which will eventually be capable of furnishing 60,000 kw electric horse-power.—*Cassier's Mag.*, July.

French Power Transmission.—SOULIER.—An illustrated description of the power plant of Bourlillon, Isere, for power transmission at 35,000 volts to Vienna, a distance of about 55 miles. The power plant contains three turbo-driven generating sets each of 1,000 kilovolt-amperes, three-phase currents at 3,800 volts being generated. The voltage is raised to 35,000, which is a very high value for France.—*L'Industrie Elec.*, July 10.

Power Plant of Department Store.—The first of a series of articles on details of the Wanamaker power house in Philadelphia. The building will be equipped with eight 663-hp, water-tube boilers, four 500-kw and six 175-kw direct-connected generators.—*Eng'ing Record*, July 23.

Effects of Vacuum on Steam Engine Economy.—NEILSON.—The concluding article of his serial on this subject. He discusses central condensers, cooling towers and auxiliary machinery of the condensing plant.—*Eng'ing Mag.*, July.

Modern Steam Traps.—A long illustrated article on the modern steam traps, explaining their construction and method of operation, and giving in many instances the steam-pipe connections essential for the best working of the traps.—*Amer. Elec.*, July.

German Electric Traction Statistics.—The annual statistical tables on electric traction in Germany. The statistics cover 233 full pages and a summary is given in an editorial. The statistics are divided into three parts, dealing with, first, those electric railways which were in operation on October 1, 1904; second, electric railways in course of erection; third, railless traction systems (there are six such systems in Germany). The following table shows the development of electric traction in Germany since 1896:

	1896.	1900.	1903.	1904.
No. of main centres of electric railway systems...	42	99	134	140
Length of lines in kilometers.....	582	2,868	3,692	3,791
Length of single track in kilometers.....	854	4,254	5,500	5,670
Number of motor cars	1,571	5,994	8,702	9,034
Number of trailers	989	3,962	6,190	6,477
Capacity of electric machines in kw.....18,560		75,608	133,151	133,326
Capacity of accumulators in kw.....	...	16,890	38,736	39,809

There is given a table which shows the capacity of machines installed per kilometer of single track or per motorcar in different cities. These figures, of course, vary greatly in different sets, according to local conditions. The highest figures are for Gotha (maximum grade 0.67 per cent) where these figures are 61.1 kw per kilometer of single track and 33 kw per motorcar. In Barmen, with a maximum grade of 2 per cent, these figures are 40.4 and 28.4 kw respectively. In Wiesloch, with a maximum grade of only 0.16 per cent, the machine capacity per motorcar reaches the very high figure of 60.0 kw. The lower figures are in the case of Bremerhaven and Frankfurt; here these figures are 7.8 and 8.6 kw per kilometer of single track and 6.6 and 6.0 kw per motorcar The average figures from 74 cities are 20.7 kw per kilometer of single track and 17.0 kw per motorcar. The system of operation has not undergone any essential change during the last year. There is still a strong tendency to substitute the trolley system for conduit systems or storage battery systems. A mixed system combining trolley and storage batteries is in use only in Dresden, combinations of conduit and trolley are used in Berlin, Dresden and Duesseldorf. "The safety of operation of conduit systems compared with the trolley system still leaves much to be desired, so that the substitution of the latter for the former is probably only a question of time." Pure storage-battery traction is in use only on a 2.5-mile road in Bremerhaven, while, on the other portions of this system, horse traction is used. The intention is to introduce the trolley system throughout. On the other hand, it is pointed out that on real railroads the storage-battery system has not been replaced, but, on the contrary, it is being introduced on additional lines. The local road between Ludwigshafen and Mundenheim is now in the 10th year of storage-battery traction and the Palatian railways in Bavaria now use storage battery traction on 10 branch roads. The same system is now being introduced on three main lines, partly to test its suitability in this case. The third rail is used on three roads, among them the elevated road and the subway of Berlin. Three-phase traction has now lost its attractions, and single-phase traction is in the foreground of interest. After the successful tests on the Niederschoenweide-Spindlersfelde road, it has been decided to employ the same system on the Hamburg-Altona road and its extensions; for this purpose a large power station with turbo-dynamos is being erected. This is the first case in which the Prussian State railways introduce electric traction on one of their roads. The system will be opened on October 1, 1906. The Siemens-Shuckert works have installed single-phase traction on the local road from Murnau to Oberammergau, which was formerly operated with three-phase currents. Careful plans are now being made to introduce the single-phase system on the Stadt-und-Ringbahn in Berlin.—*Elek. Zeit.*, July 13.

Lighting and Power From Railway Circuits.—An editorial discussion of this subject. If the fluctuations of a railway load are such as to forbid lighting directly from alternating-feeder circuits, it is still possible to get good service by using motor-generators for the lighting load. Every long railway system has scattered sub-stations which require attendants, and, by installing small motor-generators in one of these, a very useful lighting service may be worked up. The question is discussed whether a railway circuit at 25 cycles can give reasonably good service directly from its wires, assuming that a district does not furnish enough business to justify sub-station working. It seems that 25 cycles is just too low a frequency for satisfactory service, at least with 16-cp, 110-volt lamps. With 50-volt lamps, particularly of 20-cp or more, the fluctuations due to fre-

quency will be far less troublesome, although those due to the variation of voltage from the railroay load would still remain. The question is then discussed whether a motor-generator set with a synchronous motor or one with an induction motor is preferable in obtaining power for lighting from a railway circuit. The advantage of a synchronous motor is that it averts all speed variations in the motor due to variations of voltage in the supply, and this may be of importance at the end of a long feeder. On the other hand, when the amount of lighting to be provided is small and it is necessary to use a motor-generator requiring the minimum of attention, the induction motor is altogether preferable. The last uestion discussed is whether voltage regulators on the fields of the generator of the motor-generator can be made to give good service in lighting when the frequency of the circuit varies 3 to 5 per cent, owing to the fluctuations in the load. This depends on the character of the fluctuations, and the purpose will be accomplished if the fluctuations are not too rapid.—*St. R'y. Jour.*, July 22.

Financial Aspect of the Electrification of Steam Railways.—BARKER.—A communication analyzing the accounts of the Mersey Railway Company in Great Britain, which has abolished the use of steam over the whole of its system, and substituted electricity in the place thereof. The half-year, which ended December 31, 1900, in which steam was used, is compared with the half-year ending December 31, 1904, in which electricity was used. The gross sum spent for working expenses by electricity was $164,415, while for steam it amounted to $164,875; the gross receipts were $208,940 for electricity and $195,-245 for steam; the ratio in the two cases being 79 per cent for electricity and 84½ per cent. for steam—an improvement of 5½ per cent in favor of the former. The train-mileage has been increased by more than 250 per cent. In 1900, 156,450 miles, and in 1904, 415,625 miles were run. Expressing the expenses and receipts in costs and earnings per train mile, the sum paid for each mile run was 39 cents by electricity and $1.05 by steam. The receipts for electric traction per train-mile were, however, 50 cents and for steam $1.25, whilst the net receipts per train-mile were 10 cents and 19 cents respectively. Unfortunately, the increase of passengers carried is by no means commensurate with the increased train-mileage. There were 5,199,976 individuals carried on the electric trains against 4,169,478 by steam, so that while it has been thought necessary to run 2½ times the number of trains, the passengers have barely increased one-fourth. Electric passengers cost 3.0 cents and paid 3.8 cents—profit 0.8 cent. Steam passengers cost 3.8 cents and paid 4.5 cents—profit 0.7 cent, but in these figures the all-important factor of additional capital expenditure is neglected. The writer assumes the rate of interest at 3½ per cent, and adds the interest on the additional capital to the working expenditure, whereby the cost per train-mile is increased from 39 cents to 69.5 cents, and taking from this the earnings per train-mile of 50 cents there is a loss of 19.5 cents on every train-mile. He thinks that this state of affairs does not look too hopeful for the extension of main line electric traction.—Lond. *Eng'ing*, July 14.

Electric Traction Without Rails.—SCHIEMANN.—A paper read before the German Assoc. of Elec. Eng., and giving a review of his system of electric motorcars being supplied from an overhead trolley line, but running on ordinary roads without rails. They are intended especially for those roads on which existing traffic is not sufficient to render traction on rails economical. The advantages of the system in mountain districts are pointed out. Whenever necessary, it is easy to place around the wheels corrugated tires to increase the adhesion on ice, etc. The first cost of a rail-less traction system is 20 to 25 per cent of a real railroad, but, of course, in the former case not the same traffic can be taken care of. The cost of operation per car-mile is about the same as on small electric tramways.—*Elek. Zeit.*, July 6.

Railway Signals.—A long illustrated description of a new system of electric signalling employed at the Derby station of the Midland Railway.—Lond. *Elec.*, June 23.

ELECTROPHYSICS AND MAGNETISM.

Hysteresis in a Revolving Field Under the Action of Direct Current, Interrupted Current, Alternating Current and Hertzian Waves.—RICCARDO ARNO.—A summary of various investigations published by him in various Italian journals. (From an article in Lond. *Elec.*, July 7, it appears that the arrangement of his experiments was as follows: A steel cylinder was suspended with its axis at right angles to the plane of the rotating field, and was surrounded by a coil through which the continuous, interrupted, alternating or oscillatory currents were passed. Fixed on the same suspension was a second cylinder in an equal but opposite revolving field without a coil. When no current flows through the coil of the first cylinder, the torques balance. But when a current is passed through the coil, the moving system deflects and is turned back to zero by a torsion head. The angle is taken as an indication of the magnetic lag in the cylinder, and, Arno assumes, also of the hysteresis.) The main results are as follows: If one uses a sufficiently strong revolving magnetic field, one always finds a diminution of hysteresis in the cylinder placed in the field, when subjected to the action of direct current, or interrupted current, or alternating current, or Hertzian waves. This diminution of hysteresis is the greater, the stronger the revolving field and the stronger the secondary magnetic field produced by the current to the action of which the cylinder is subjected. If one employs a revolving magnetic field of feeble intensity one may get an increase of hysteresis; this will be the case as long as the strength of the secondary field is not above a certain value; if it becomes greater than this value a diminution of hysteresis is observed. There exists always a certain value of the strength of the revolving field for which the increase of hysteresis is a maximum, and a certain value of the strength of the revolving field for which the hysteresis is neither increased nor diminished. If one uses weak revolving fields there exists always (for a given revolving field) a certain value of the strength of the secondary magnetic field for which the increase of hysteresis is a maximum; and a certain value of the secondary field for which the hysteresis is neither increased nor diminished. If the hysteresis is increased, the increase is smaller for direct currents than for interrupted currents or alternating currents. If the hysteresis is diminished, the diminution is greater for direct currents. If one submits the magnetic cylinder to the action of a direct current, he may choose the conditions so that the hysteresis is neither increased nor diminished; in this case if one employs an interrupted current or alternating current an increase of hysteresis is observed. On the other hand, one may subject the magnetic cylinder to an interrupted current or an alternating current and choose the conditions so that the hysteresis is neither increased nor decreased; then under the same conditions a direct current will give a diminution of hysteresis. It is possible that the same conditions may give a diminution of hysteresis with direct current and an increase of hysteresis with interrupted or alternating current. The increase of hysteresis is the greater the higher the frequency of the alternating current or the higher the frequency of the interruptions of the interruptd current. The diminution of hysteresis is the greater the smaller the frequency of the alternating current. If a magnetic cylinder is submitted to the action of an alternating current of given frequency one may choose the conditions so that the hysteresis is neither increased nor diminished; if the frequency is then increased, the hysteresis is also increased. On the other hand, if the frequency is diminished the hysteresis is also diminished. Finally, it is possible that under otherwise the same conditions, an alternating current of a certain frequency may give a diminution of hysteresis, while with a higher frequency the hysteresis is increased.—*L'Industrie Elec.*, July 10.

Magnetic Alloys from Non-Magnetic Metals.—FLEMING AND HADFIELD.—An account of an investigation of a sample of Heusler's alloy. A sample consisting of 60.49 per cent copper, 11.65 aluminum, 22.42 manganese and no iron, was found to exhibit magnetic properties identical with those of a feeble ferro-magnetic material. The magnetization (or B. H.) curve is of the same general form as that of a ferro-magnetic metal such as cast iron, and indicates that with a sufficient force, a state of magnetic saturation would most probably be attained. The alloy exhibits the phenomenon of magnetic hysteresis. It requires work to reverse the magnetization of the material and to carry it through a magnetic cycle. The material has a maximum permeability of 28 to 30, which is not greatly inferior to that of the values reached for cobalt or a low grade of cast iron for small magnetic forces, and occupies a position intermediate between the permeability of the ferro-magnetic and the merely para-magnetic bodies, such as liquid oxygen and ferric chloride. The material exhibits, therefore, the phenomenon of magnetic retentivity and coercivity. It is not merely magnetic, but can be permanently magnetized. The authors are led to the conclusion that the magnetic properties of this alloy must be based on a certain similarity of molecular structure with the familiar ferro-magnetic metals, and that ferro-magnetism of itself is not a property of the chemical atom, but of certain molecular groupings. It may be possible to construct alloys which are as magnetic, or even more magnetic than iron itself.—Lond. *Elec.*, June 16.

Electrochemistry and Batteries.

Electrolytic Manufacture of Fine Wires.—Abraham.—An account of experiments in which he succeeded in preparing very fine and uniform wires by the partial decomposition of a wire in an electrolytic tank. The diameter of the wire is controlled by measuring its resistance, and for this purpose it is attached to metallic rods at both ends. It hangs in the liquid, which does not touch the rods. The solution must be very dilute, and the action slow. The resistance is concentrated in the immediate neighborhood of the wire. The author uses distilled water containing a few thousandths of its weight of copper sulphate for copper wires, or silver nitrate for silver wires. The current employed is about 10 milliamperes per square centimeter of surface of the wire. It must be reduced as the wire becomes thinner. This current intensity allows time for the products of electrolysis to diffuse through the electrolyte. The resistance then keeps highest at the thinnest portions of the wire, and thus regulates the process of solution. The breaking stress of the wire is inversely proportional to its resistance.—Lond. *Elec.*, June 23; from *Comptes Rendus*, May 29.

Units, Measurements and Instruments.

Measuring the Slip of Induction Motors.—Clinton.—A communication with reference to the recent article of Bailey (Electrical World and Engineer, April 22, 1905, p. 756). The author states that the same method has been used by Seibt, who employed the pulsation of light of an incandescent lamp as indicator, and also obtained permanent records by the introduction of a Morse printer into the circuit. Both methods have been used by the present author for some time and have proved successful. The circuit consists of a lamp in series with a contact breaker on the motor shaft fed from a pair of the stator terminals. When required, the Morse printer is put in series with the lamp. The writer has found that the lamp can be used without difficulty as long as the pulsations of light do not exceed more than about two or three per second. With greater frequencies the counting is difficult, and the use of the Morse printer with its permanent record is to be preferred.—*Lond. Elec.*, June 23.

Correcting Factor of Wattmeters.—Smith.—The correcting factor of a wattmeter with which its reading must be multiplied to get the true watts is due to the self-induction of the pressure coil; this cannot be absolutely avoided, although it may be made practically negligible. The author has studied the magnitude of the correcting factor by the use of the oscillograph. He assumes that, so long as the current in the fine wire coil is to all appearances in phase with the e.m.f. at its terminals, the correcting factor is unity.—Lond. *Elec.*, June 23. Edgcumbe.—A communication, in which the writer objects to the conclusion in the last sentence in the preceding abstract. He points out that a small angle of lag in the fine wire coil would produce a very serious error in the indication of a wattmeter, particularly at low-power factors. He describes a method by which the correcting factor can be determined under working conditions, if two similar watt-meters are available. One of these instruments is to be connected up in the ordinary way, and a switch so arranged that the moving coil of the second wattmeter can be connected in series with that of the first, an equal amount of resistance being at the same time cut out of circuit. Now, it can be shown that very approximately the error

$$\text{is proportional to } \frac{\textit{self-induction}}{\textit{resistance}} \times \tan \phi \text{ at constant frequency, where}$$

$\cos \phi =$ the power factor of the main circuit. Now, by the above device the self-induction of the circuit is doubled, while at the same time the resistance is kept constant, and consequently the error in the indication has been doubled. In other words, the change of reading produced by substituting the moving coil of the second wattmeter for an equivalent non-inductive resistance is equal to the original error due to self-induction, and this under actual working conditions. although the error due to self-induction is an important one it is easily estimated, easily allowed for and easily rendered negligibly small, and a great deal too much has, the writer thinks, been made of it in the past. He thinks that a more insidious trouble is due to eddy currents.—Lond. *Elec.*, June 23.

Cathode Ray Tube.—Varley and Murdoch.—An illustrated article describing several applications of the Braun cathode-ray tube for experiments with alternating currents and for demonstration purposes.—Lond. *Elec.*, June 16.

Measuring the Moment of Inertia of Armature.—Boehm-Raffay.—A description of Fabry's method of determining the moment of inertia of the armature of a dynamo by observing the decrease in speed after the current supplied to the motor has been interrupted while the excitation is maintained constant.—*Elek. Neu. Anz.*, June 15.

Deep Borehole Surveying.—Marriott.—An illustrated paper describing electrical devices for deep borehole surveying. First there is described a continuously recording instrument for determining dip in a borehole and then an intermittent recording instrument for the same purpose.—*Eng'ing News*, July 27.

Leakage Indicator.—Raphael.—With reference to recent regulations as to the use of electricity in mines in Great Britain, several instruments are described by means of which the leakage current from the installation may be measured and the occurrence of a fault immediately recorded.—Lond. *Elec.*, June 16.

Electricity Meters.—Gerhardi.—Continuations of his illustrated serial, describing various types of prepayment meters.—Lond. *Elec.*, June 23, 30.

Miscellaneous.

Reinforced Concrete.—Noaillon.—Apaper read before the (Brit.) Inst. of Mech. Eng. on "ferro-concrete" and some of its most characteristic applications in Belgium. Although unknown to the general public a few years ago, this material has now entered with phenomenal rapidity in all branches of structural work.—Lond. *Elec.*, June 23.

Pioneer Work in Electric Engineering.—Elihu Thomson.—An address giving personal recollections of the rise of the electrical industry, especially in Lynn, Massachusetts.—*Eng'ing. Mag.*, July.

BOOK REVIEWS.

Testing of Electro-Magnetic Machinery and Other Apparatus. By B. V. Swenson and Budd Frankenfield. New York: The Macmillan Company. Volume 1. Direct Currents. 420 pages, 150 illustrations. Price, $3.00.

The arrangement of this book is well planned and systematically carried out. Each experiment is treated as a separate unit, and the descriptive matter relating thereto is not abbreviated by reference to previous experiments. This method of treatment is excellent for flexibility in the application of the text to any chosen list of experiments. The authors have very properly laid great stress on this feature, and they have met good success in applying the method without excessive increase in the size of the volume.

After having described the various testing instruments and the methods employed for their calibration, the testing of the component parts of the machine is taken up under magnetization and resistance measurements. The book then deals with the characteristics of completed machines, and the operation of machines singly and in pairs under normal and exceptional conditions. Much attention is given to the efficiency tests of dynamos and motors, proper emphasis being laid upon the value of the stray-power and loading-back methods of testing. The book covers 96 separate tests, the character of which indicates that considerable care has been exercised in their selection.

With the description of each test is given a brief outline of the theory of the machine under the conditions to which it will be subjected, so that the student may gain a fair idea of what the test is expected to prove. The book is essentially a laboratory manual for students, and has not been written for the factory. In an appendix, however, a brief outline is given of the tests which are employed by the manufacturers of direct-current machinery. The authors have been exceptionally liberal in their references to the works of others. The completed list of references to similar experiments as described by others, which is given with each test, adds materially to the value of the book as viewed by the instructor.

Die für Technik und Praxis Wichtigsten Physikalischen Grossen. (The Principal Physical Magnitudes of Technics and Practice.) By Olof Linders. Cloth, 396 pages, 43 illustrations. Leipzig: Jäh & Schunke. Price, 10 marks.

The book contains a systematic analysis of the various geometrical, mechanical, thermal, optical, electrostatic, magnetic, electrodynamic and electromagnetic units in practical use. The mutual relations of these units are developed tabularly with respect to various systems employing the centimeter, decimeter and meter as units of length; the

gramme, kilogramme, 100 kilos and metric ton as unit of mass, and the mean solar second as unit of time. A large amount of labor must have been expended by the author in arranging the tables, which are useful for reference. As may well be imagined, there is difficulty in denoting the eight different sets of units in such a manner that the algebraic symbols may not be confused. The author suggests several kinds of type and also resorts to Greek and Russian letters, besides English and German characters. To this plan we take no exception. Anyone who attempts to write out eight sets of units in their proper notation will realize the need either for different alphabets or for different fonts of type in international use. It is of much less consequence what types are used than that some international agreement should be arrived at between the writers of text-books. For this purpose the Russian language characters might be as useful as the Greek.

The value of the book seems greatest in its general classifications and far-reaching development. So far as concerns electric and magnetic units, we think that there is much omitted that might be included with advantage. Thus no allusion is made to the fact that the volt-ampere-ohm system of units or practical system is virtually a quadrant-eleventh-gramme and second system or Q. E. S. system, as was first shown by Maxwell. Again, no reference is made to the Giorgi system, the Fleming system, the Fessenden system, the Kennelly proposals, the very important Hospitalier notation, or the relations of kappa and mu involved in the C. G. S. system, as was first shown by Rücker and developed by Gray. From an electromagnetic point of view, therefore, the treatment is very elementary and meagre. We hope that these omissions may be made up in the next edition.

Chain Making by Electric Welding.

In a recent issue of the Iron Age there appeared an interesting article by Andris-Jochams, of Brussels, Belgium, describing the Gibaud process for welding chains by electricity. This process, which receives its name from the inventor, Eugene Francois Gibaud, of Poulaincourt, France, is characterized by economy and rapidity of operation, and superiority of product.

In forming and cutting chain links by the Gibaud process there

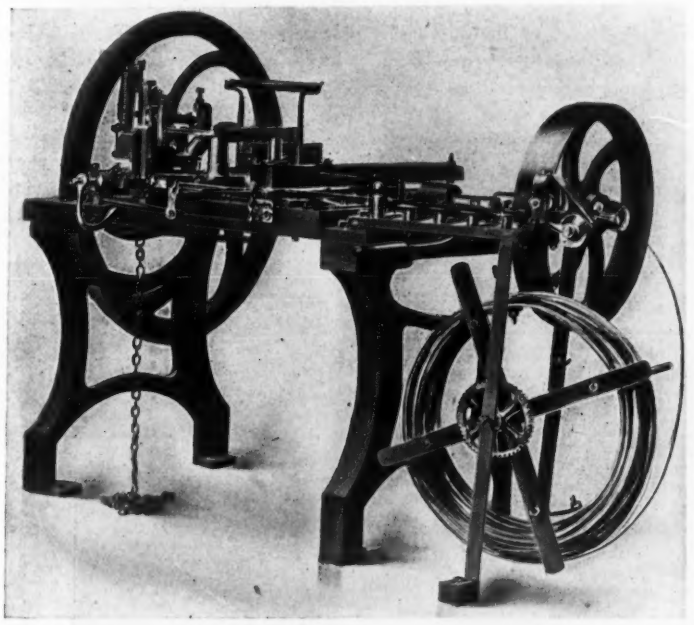


FIG. 1.—BENDING MACHINE.

is required only a single machine, a view of which is given in Fig. 1. This machine is entirely automatic in its operation. The coil of stock is placed on the reel and the end started through the straightening rolls into the feeding mechanism of the machine, after which it is cut and bent automatically into links of uniform dimensions. Each new link of stock is passed through the last completed link and bent in that position, so that the links issue from the machine assembled in a continuous chain. The weld is made on the side of the link instead of on the end, as in the former processes, and the ends instead of being scarfed at an angle of 60 degrees are cut square and left about 1/16 in. apart ready for butt welding. On the bending machine, shown in Fig. 1, 20,000 links of 9/32-in. stock can be cut and wound in one day, 5 horse-power being required for driving. The links being ready to weld are fed into the welding machine, illustrated in Fig. 2.

The chain is passed through the machine twice, as only alternate links can be welded at each passage without revolving the entire chain 90 degrees about its axis for each succeeding link. In the

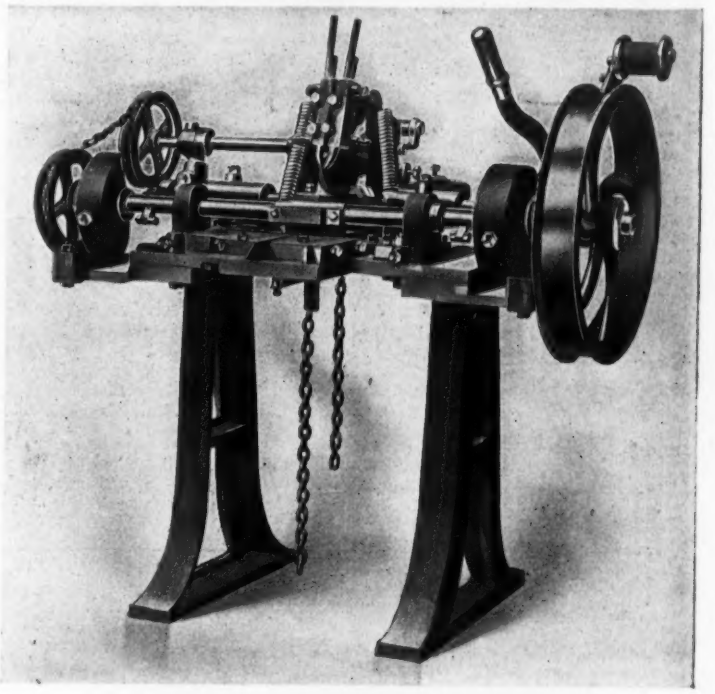


FIG. 2.—WELDING MACHINE.

machine each link to be welded is brought in contact with two electrodes, one on either side of the split in the link, and current is passed until a welding heat is reached. Meantime slides carrying dies adapted to engage the ends of the link press the joint together. After the weld has been effected and while the metal is still hot a spring-actuated hammer, having a semi-cylindrical groove in its face, strikes the link against an anvil with a correspondingly grooved face. This removes the fin formed during welding and finishes the surface. These machines are made both automatic and non-automatic. The best work is performed on a non-automatic machine, which may be operated by unskilled labor.

The first and most important consideration in any welding process is the certainty of securing a perfect weld. In the Gibaud welders, the link is firmly secured in the welding clamps in full view of the operator. As the current is applied the ends of the link may be watched while they come to the proper heat, and the current can be cut off at the right moment. The current is applied just where the ends abut, and then the ends are forced together. The moment the two ends touch, the current crosses and the resistance of the metal at the point of contact produces the heat necessary in welding. There is no waste heat, as the heating does not commence until the ends are in contact, and when the weld is made the current is cut off.

A link heated in a fire is heated from the exterior inwardly; consequently the outer surface reaches the welding heat first. It is often the case that when the appearance of the link would indicate that the proper heat has been reached it is in reality heated insufficiently in the interior, so that when a weld is attempted it will stick together only on the edges. In electric welding, on the other hand, the heat is developed first in the interior and makes its way out, so that when the usual white sparks are emitted it is known that the entire joint is heated to the welding temperature.

The heated portion of the link to be welded is not exposed to the air, as in the fire welding process where oxidizing occurs, forming scale that often prevents a perfect weld. There is no noise, no dirt, no intense heat to contend with, no waste due to overheated or imperfectly welded links and no dependence on skilled labor.

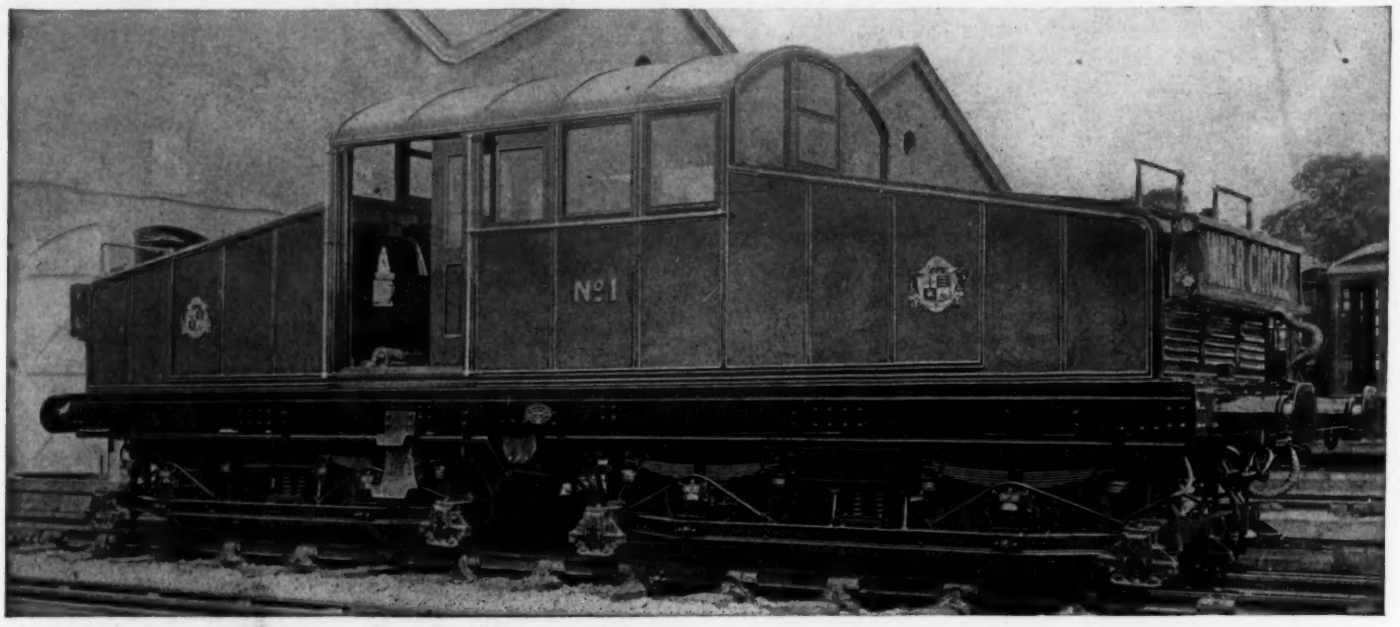
With electric welding perfect homogeneity is secured, which may

not be said of welds secured by any other process. Tests show that the conductivity of the weld is just the same as that of the body of the material and in some cases actually higher. The molecular structure of the welded part is exactly the same as the rest in the case of electrically welded steel, while in electrically welded iron the fiber and structure are as perfect as before the weld is made. There is no danger to the operator in handling the welding machine, for though the quantity of the current used is large, the potential at which it is applied is very low and the welding terminals of the machine may be touched without injury. It is stated that chains may be made by the Gibaud process at a cost to compete successfully with those made in any quantity by any other process.

Electric Locomotive for London Underground.

The first of ten 50-ton electric locomotives supplied to the Metropolitan Railway, London, is herewith illustrated. Each locomotive has four motors of 300-hp. each, or 1,200-hp. in all, but as the terminal facilities are somewhat restricted, it has been found necessary to use smaller motors than usual for such a type of equipment, and to supply forced ventilation, in order to keep the length of the locomotive within the space available at the termini for handling them. Under these conditions, very satisfactory results it is understood have been secured. The locomotives are being built by the British Westinghouse Company.

At first these locomotives will be used for hauling the main line trains between Harrow and Baker Street, the steam locomotives which do the hauling from Aylesbury being dropped at Harrow and picked up again for the return trip. The train load is 120-tons, and the new locomotives are to make a speed of 36 miles an hour. The same locomotives are to be used on the Metropolitan half of the "Inner Circle" underground for goods traffic, and for hauling the steam trains of the other companies that possess running powers over the system. Trains will thus be picked up by the electrics at Edgeware Road, the steam locomotives resuming their functions at the point where the train leaves the Inner Circle.



ELECTRIC LOCOMOTIVE FOR METROPOLITAN RAILWAY, LONDON.

Storage Battery Locomotive in Power House.

In the new power house of the Interborough Rapid Transit Company, ashes, after being quenched, are carried away from beneath the boilers in cars drawn by an electric locomotive illustrated herewith. This storage battery locomotive is articulated and rounds curves with great readiness and with less overhang of corners than if constructed in but one unit. This matter is of great importance where there is lack of space.

The motors are not supported on the axles, but on springs and placed above the platform and away from the dust and mud. They are subject to little jar, consequently being less liable to injury. The

STORAGE BATTERY LOCOMOTIVE.

axles are driven by silent chain, thus permitting the axle boxes to rise and fall independently of motors, which are of the highest grade and show 90 per cent efficiency. This high percentage of efficiency is called for in order to economize consumption of current and for the same reason the control is of the multiple unit system and is made entirely without starting resistance. The arrangement of control also calls for an even output of energy from each cell, so that no one bank may be exhausted before the others. The wiring of cells and design of trays has been carefully worked out to obviate the leakage of current and local short circuits.

The locomotive has a height of but 4 ft., and will easily round a curve of 12 ft. radius. The vital parts are well protected but so placed that they are very easy of access from the top should repairs be necessary, therefore, no pit is needed.

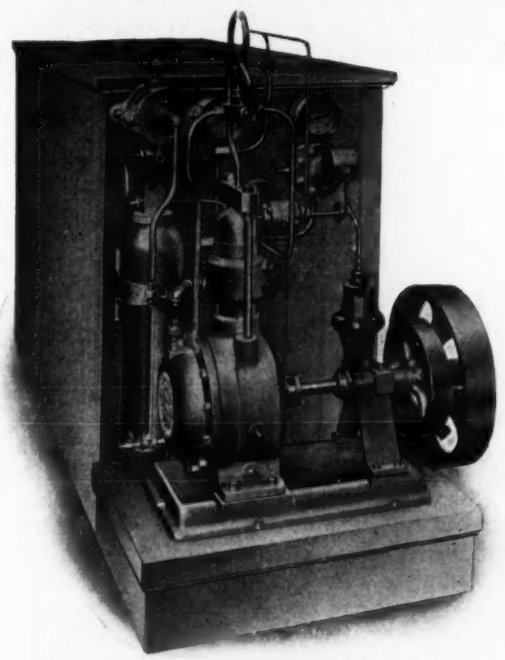
The locomotive has developed a draw-bar pull of over 2,000 lbs., thereby showing that it is capable of hauling 200 tons or more.

Brushes are fitted to the ends of the locomotive to clear the supporting rails from any ashes or dirt which may have fallen on them.

This locomotive was designed and constructed by the Robins Conveying Belt Company, of New York, who a short time ago completed the installation of the entire coal and ash handling system for the above power house, consisting of hoisting tower, belt conveyors, scraper conveyors and industrial railroad.

Sanitary Refrigeration.

Of the many advantages offered by mechanical refrigeration in comparison with the success of obtaining low temperatures by means of ice, not the least important is the elimination of the moisture and the attendant disease germs. It is now known that many epidemics have their origin in the ice that is used for household purposes, and that disease germs are not exterminated by mere freezing. It has been fully demonstrated, however, that all such disease germs are destroyed by boiling the water. The accompanying illustration shows a



AUTOMATIC ICE PLANT COMPLETE.

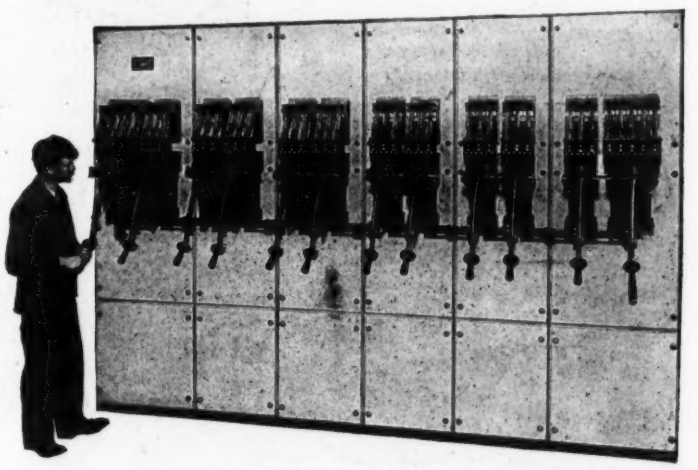
combined ice-making and refrigerating machine which is attached to a household refrigerator box and secures to the user hygienic ice and pure sanitary refrigeration.

These machines are thoroughly automatic and are as free as possible from complications. The household plants are arranged to be operated from 8 to 10 hours per day, sufficient cold being stored during this time to maintain the temperature throughout the night while the machine is idle. The compressor can be operated by any available power, electricity being the most desirable where it can be obtained. These plants are built by the Brunswick Refrigerating Company, New Brunswick, N. J.

The plant was designed particularly for export and is meeting a long-felt want abroad. The plant is absolutely complete in every detail, the machine and ice-making compartment occupying the same base and being shipped as a unit. It is only necessarw for the purchaser to connect power by belt and water under pressure for condensing purposes when the machine is ready to operate. The machine is fully charged with anhydrous ammonia, and the charge should last from 8 to 10 months. Ammonia is also furnished in special cylinders, which are interchangeable, each cylinder containing a full charge of ammonia or 8 to 12 months' supply. In putting on one of these cylinders it is only necessary to remove the old one and replace the new one, which can be done in ten minutes, thus doing away with the trouble and annoyance of purchasing ammonia in large cylinders and charging the machines in the old style.

A Large Motor Controller.

The cut herewith shows what is probably the largest capacity electric motor controller ever built, it being one of two designed and constructed by the Cutler-Hammer Mfg. Company, of Milwaukee, for the Carnegie Steel Company, of Pittsburg. The panels are of white Italian marble, their total dimensions being 11 feet long and 7 feet 8 inches high. The first and last switches have a continuous capacity of 10,000 amp. and the intermediate switches a continuous capacity of 6,000 amp. The levers with which the swtiches are operated are a trifle over 3 feet long, but by means of a toggle-joint action they can



MOTOR CONTROLLER.

be easily thrown into contact. Before these two controllers were built, there was but one extra large capacity controller in the United States, that being installed over a year ago in the plant of the Pittsburg Reduction Company, at Massena, N. Y. That apparatus was of 6,000 amp. capacity on first and last switches and 3,500 amp. capacity on intermediate switches and was installed on 500-volt circuit. Those for the Carnegie Steel Company will be installed on a 250-volt circuit. The resistance for these starters is composed of steel rails arranged in a rack 19 feet high, 30 feet long and 14 feet wide.

Willans-Robinson-Parsons Steam Turbine.

The Willans & Robinson Co., Ltd., of England, have taken out a license to make steam turbines under the Parsons patents, and have now brought up their type of the familiar parallel flow turbine, the changes being more particularly in processes of manufacture and details of design.

Among the features thus receiving special attention and modification are the governor gear, oil pump, steam and water piping, etc., as it has been found that ability to inspect the working portion of a turbine without dismantling any attendant gear is a convenience appreciated by those who have to take charge of the running and maintenance of machinery. To enable this to be attained, all the gearing and fittings named above are mounted on the bottom half of the bearing pedestals, and the top cover of the turbine as well as the bearing caps of the three main bearings, are left free for instant removal. To further facilitate opening the turbine, the top half of the casing has been arranged with two hinges, thus avoiding the use of guide studs and placing the turbine cover in

a suitable position for examination. In the case of the 1,000-kw Willans-Parsons turbine, it is possible for two men to remove the main bearing caps and to open up the turbine for inspection in less than an hour. A view of the turbine opened up in this manner is shown in Fig. 1.

It has been found possible by a rearrangement of the balancing passages to shorten somewhat the length of the ordinary parallel-flow turbine, and, further, by Mr. Fullagar's system of balancing, it has been found possible to dispense with the large balance piston at the high-pressure end of the turbine and to substitute in its place one of considerably smaller dimensions at the low-pressure end. In practice, it is said, this method of arranging the balancing pistons has the advantage of enabling castings of a more symmetrical form to be adopted, and in this way many of the troubles brought about by unequal expansion of the different parts are avoided.

What is considered an improved method of attaching the blades to the rotor and casing has been adopted. Extraordinary stiffness and rigidity is given to the blade rings when they have been fitted into their respective body or shaft grooves. In the ordinary turbine of this type each blade is fixed separately into the rotor and casing by means of its own caulking piece. As will be seen from Fig. 2,

FIG. 3.—VIEW OF SHROUDING AROUND BLADES.

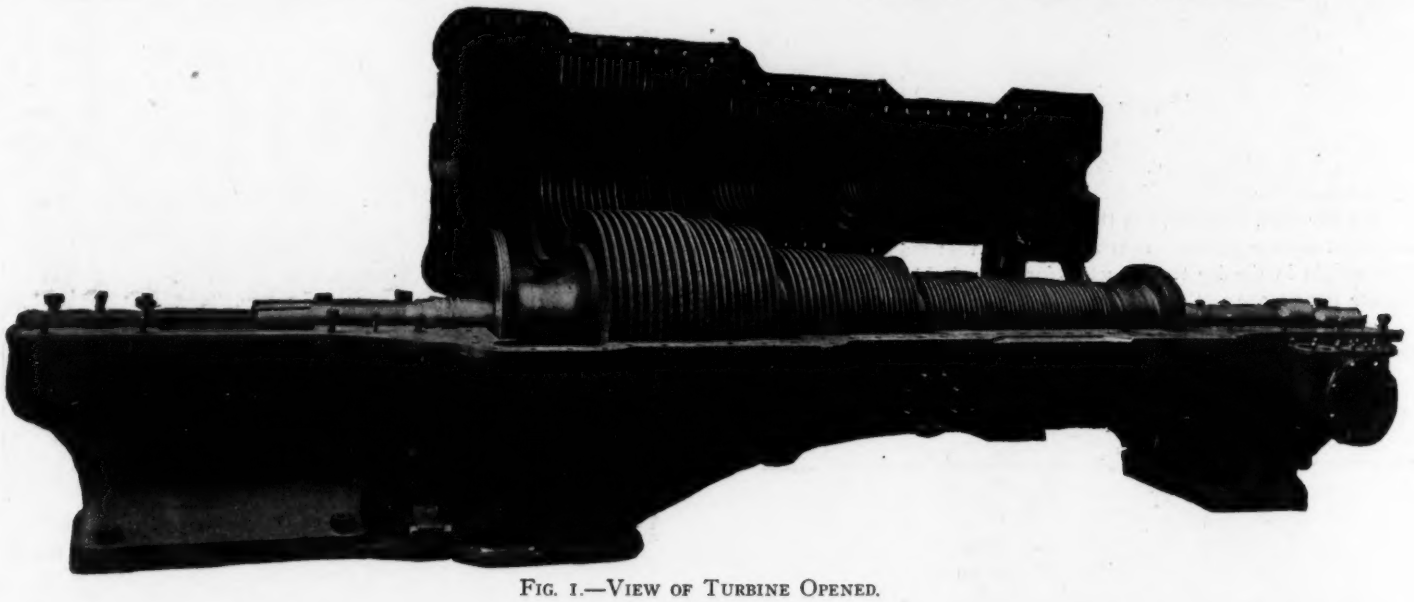


FIG. 1.—VIEW OF TURBINE OPENED.

the blades for one complete ring are built up on two half rings, which rings have had the necessary grooves for receiving the blades

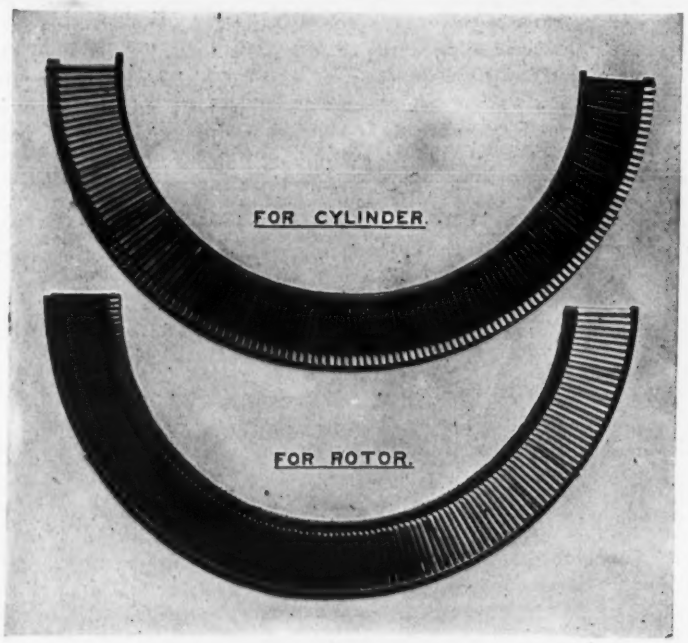


FIG. 2.—HALF RINGS COMPLETE READY FOR ASSEMBLING.

cut in them by means of automatic machinery. These complete half rings of blades are then caulked into the shaft or the casing. Attention might be drawn to the fact that the cutting and assembling of the blading by means of specially designed automatic machinery insures that the whole of the blade angles and openings on which the efficiency depends are mathematically correct. Fig. 2 shows two of these half rings complete for assembling on the shaft and in the casing.

A special feature of the Willans-Parsons turbine consists in the interesting channel shrouding encircling the blades which this manufacturer has the right to use under the patent of Mr. Fullagar. This shrouding is fixed on the half ring of blades before assembly on the shaft or in the casing, and has several points of merit. It adds materially to the mechanical strength of the blades themselves and removes any danger of the blades stripping should the rotor come into contact with the casing, or the blading on the casing come into contact with the revolving shaft. Further, the action of the channel shrouding when under working conditions minimizes the loss due to leakage over the revolving or fixed rows of blades, and by this means a considerable gain in the steam economy is effected. A view of the shrouding around the blades is shown on the right-hand side of Fig. 3.

As already noted above, special attention has been paid to the question of governor gear with a view of making it as simple and as reliable as possible. By dispensing with some of the intermediate gears it has been found possible to obtain results in the direction of close governing which it is believed surpass anything hitherto obtainable. All the turbines are fitted with by-pass valves, which automatically open when the maximum economical output of the turbine is exceeded, and by means of these by-pass valves any required overload can be obtained up to the full capacity of the generator, the steam economy of the turbine being, of course, reduced.

The Willans-Robinson Company has 24,250 kw of this type of turbine at work or nearing completion, the smallest at the present

time being of 750 kw normal capacity and the largest of 5,000 kw normal capacity. Among others might be mentioned the following: Two 3,000-kw and one 1,500-kw for the Glasgow Corporation; two 1,000-kw for the Bristol Corporation; one 3,000-kw for the Metropolitan E. S. Company, London; two 1,000-kw for Bruce, Peebles & Company, Ltd., and one 1,000-kw for Messrs. Watson, of Linwood; also three 750-kw for the English McKenna Steel Process Company, Ltd., Birkenhead.

Automatic Ore Unloading by Electric Motor.

Among the notable applications of electricity to heavy service in industrial operations, is that adopted in the unloading of iron ore from boats at various lake ports. In this connection, the accompanying illustrations of two electrically-operated Hulett automatic ore unloaders at the docks of the National Tube Company, Lorain, Ohio, will be of especial interest. These views represent the latest installation of these rapid unloaders. An idea of the heavy service required of these machines may be had from the fact that they handle an enormous grab bucket, which automatically digs and conveys from the hatches of the boat 10 gross tons of ore at a load. This grab bucket is carried at the lower end of a vertical dependent leg suspended from a pivoted walking beam which is carried on a carriage or trolley which travels back and forth on the girders of the machine. The entire machine is mounted on moving trucks, enabling it to travel up and down the dock, from hatch to hatch of the boat, without moving the boat. The leg carrying the boat is always maintained in a vertical position, and the operator who controls all the motions of the bucket rides at the lower end of the leg directly above the bucket. By means of hoisting mechanism, the walking beam is made to oscillate up and down, carrying the bucket down into the hold of the boat, and up above the dock. The travel of the trolley back and forth on the girders carries the walking beam and the bucket out over the boat and back again over the dock. To reduce the trolley travel as much as possible, suitable hoppers for receiving the contents of the bucket are mounted between the girders at the front. These hoppers discharge into an auxiliary bucket car which carries the ore back to the stock pile. As there is a high bank back of the Hulett unloaders at Lorain, each machine is provided with special cantilever extensions designed particularly for delivering the ore on this bank. The bucket car travels on the cantilever extensions to any desired point and automatically dumps its load, returning closed to its position under the hopper.

FIG. 1.—VIEW OF AUTOMATIC ORE UNLOADER.

The dependent leg of the unloader carrying the bucket is mounted on rotating trunnions in the walking beam, so that it can rotate in a circle when operating in the hold of the vessel, allowing the bucket to reach out in all directions. The bucket is opened and closed by specially designed motors, its total spread when wide open being 18 feet, and by telescopic motion it can reach, when open, more than half way from the center of one hatch to the center of the other. It also travels lengthwise of the hatch to the sides of the boat; consequently the operator is able to reach almost the entire cargo. In ordinary boats there is no difficulty in reaching 90 per cent of the cargo, and in some of the modern boats the Hulett unloaders have actually unloaded 97 per cent without the help of shovelers. With slight modification they can be adapted for use in connection with the ordinary tramp ocean steamer to even better advantage than with lake boats. They handle successfully, any kind of lump ore, digging through to bottom easily and rapidly.

A special feature of these unloaders at Lorain is the fact that they are mounted on swiveling trucks. The docks at the point where these unloaders are located are curved to such an extent that while the ends of the boat touch the dock at intermediate points there may be as much at 12 feet of open space between the dock and the boat; the tracks on which the unloaders travel being correspondingly curved,

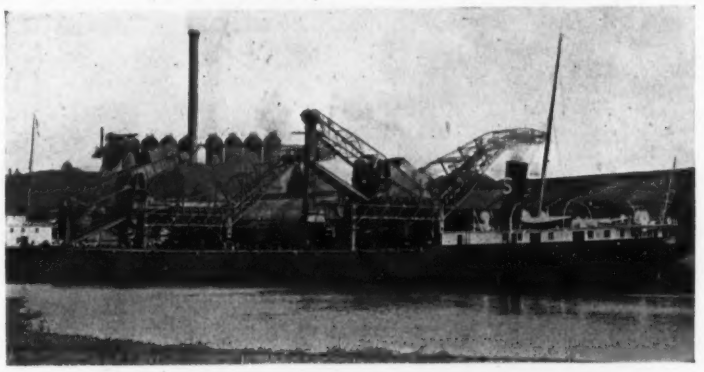


FIG. 2.—UNLOADING A STEAMER.

the swiveling trucks were provided to permit of easy squaring of the unloader leg and bucket to any hatch of the boat. The walking beams are located at the top of these machines and the parallel bars below; this arrangement permitting very advantageous distribution of materials employed, and also simplifying the matter of counterbalancing.

The bucket operater who rides into the hatch and out over the dock with the bucket, controls all motions of the machine except travel from hatch to hatch and operation of the bucket car; his position in the bucket enabing him to watch the work to the best advantage. Another operator controls the moving of the machine from hatch to hatch, and also the operation of the bucket car.

The Hulett unloaders may be arranged for steam or electric operation as desired. Those at Lorain are, as stated, electrically operated, the power being supplied from motors which take their current through sliding contacts from rails laid along the dock. The motors

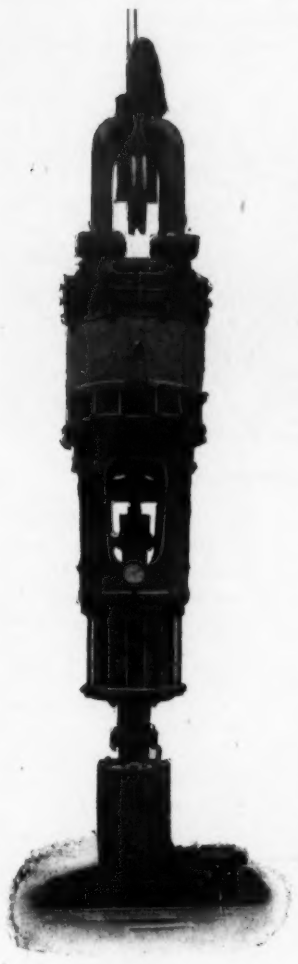
FIG. 3.—ANOTHER VIEW OF UNLOADER.

for operating the bucket are 110 horse-power, those for hoisting the walking beam 150 horse-power, those for trolleying in and out 50 horse-power, and those for operating the bucket car and moving the machine 150 horse-power. The hoisting and trolleying may be done simultaneously, speeds being figured to produce a round trip a minute. The controllers are of magnetic type especially built for heavy service.

The unloader is the invention of Mr. Geo. H. Hulett, third vice-president of The Wellman-Seaver-Morgan Company, Cleveland, O., who are exclusive builders of these machines. The same company has already done a great deal of work of similar character, inside iron and steel works, for the charging of furnaces, etc., and its machinery for such purposes is in use in large plants on both sides of the Atlantic. This apparatus is usually associated with electric motors, its practicability, indeed, often depending upon the employment of electric power.

Electrically-Driven Sinking Pumps.

An interesting form of electrically-driven sinking pump is shown in the accompanying illustration. The pump is designed for a discharge of 500 gallons per minute under a head of 300 ft. It is driven at 1,150 r.p.m. by a four-pole motor wound for 500 volts.



SINKING PUMP.

The motor is connected to the pump by a flexible coupling. Ball bearings are used at the top of the motor case to take the weight of the armature, and ball bearings are placed above the pump to carry the weight of the impellers. In order to minimize the space occupied by the equipment, the passageway for the discharge of water from the pump is carried up between the poles of the motor, so that not only is much room saved, but the pipes are protected from damage in sinking and blasting operations, and the motor is kept cool. The four-fold discharge pipe is combined in a junction pipe which also carries a sheave around which is passed a wire rope for the purpose of raising and lowering the pump in the shaft.

The pump equipment is of moderate weight and is generally compact and easy to handle. Special precautions are taken to insure that no danger can occur to any portion of the pump from blasting operations. There are provided arrangements for allowing the pump to continue to run while lifted clear of water.

These novel pumping equipments have been designed by Mather & Platt, Manchester, England, for use in the Dutch East Indies and along the northeast coast of England.

Purification of Water for Boilers.

When central power plants are installed for the furnishing of electric current, it is naturally not possible, at all times, to select a location where the water for use in the boilers is entirely suitable, and many boiler plants must contend with great difficulties on account of being located where only hard water is obtainable. As is well known to all engineers, the use of this hard water is extremely derogatory to the boilers, much scale or sludge being deposited on the plates or on the tubes. This deposit necessarily causes overheating of the plates and the burning out of the tubes if the scale is not regularly removed, and entails considerable loss of heating power.

The photograph reproduction of Fig. 1 shows a type of water softener which has been constructed for removing the impurities from the water. The general design and principle of its action are indicated in Fig. 2.

The hard water is admitted into a syphon tank containing a float which is mechanically connected with two displacers. When the water rises in this tank the displacers are drawn out of the tanks containing the lime water and soda solution, which are then automatically filled up to a given level by means of ball cocks. The syphon tank is so arranged that it discharges its contents automatically when the water reaches a certain level, thus ensuring an exact quantity of water being discharged at each emptying. The ball cocks in the reagent tanks are set to fill the tanks to a point just below the discharging troughs, so that when the displacer enters, say, the lime tank, a bulk of lime water exactly equal to the portion of the displacer submerged is pushed over into the mixer. The displacer is capable of easy adjustment so that any smaller or large quantity of lime water can be delivered to suit the chemical nature of the hard water then being dealt with. The displacer in the soda solution is similarly arranged. It will thus be seen that the discharge of the reagents is exactly dependent on the quantity of water to be softened. If this is reduced, the syphon tank fills fewer times per hour, and consequently the number of times the displacers work is reduced in the same proportion.

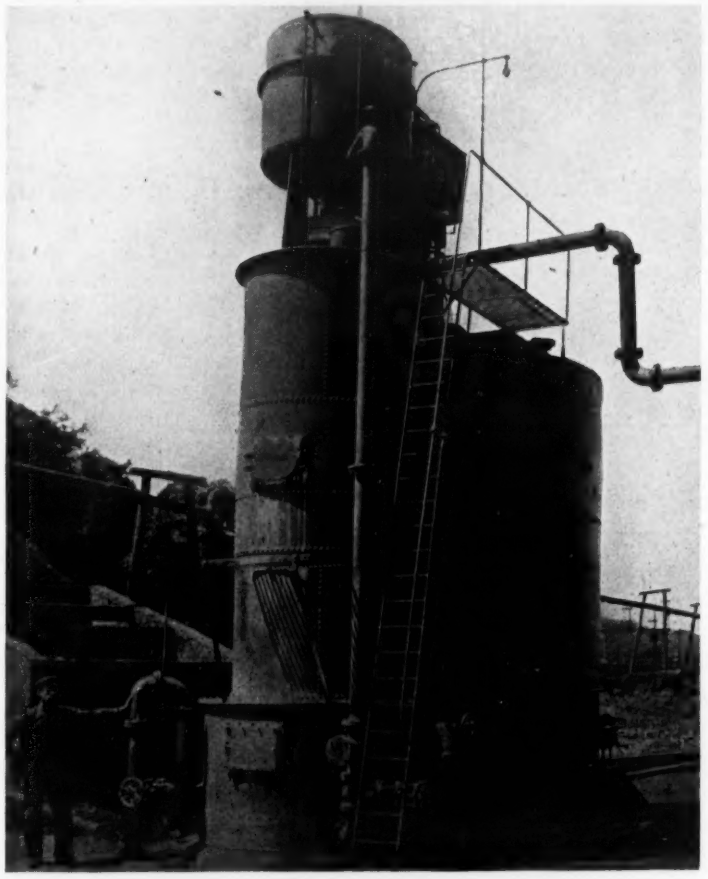


FIG. 1.—"CRITON" WATER SOFTENER.

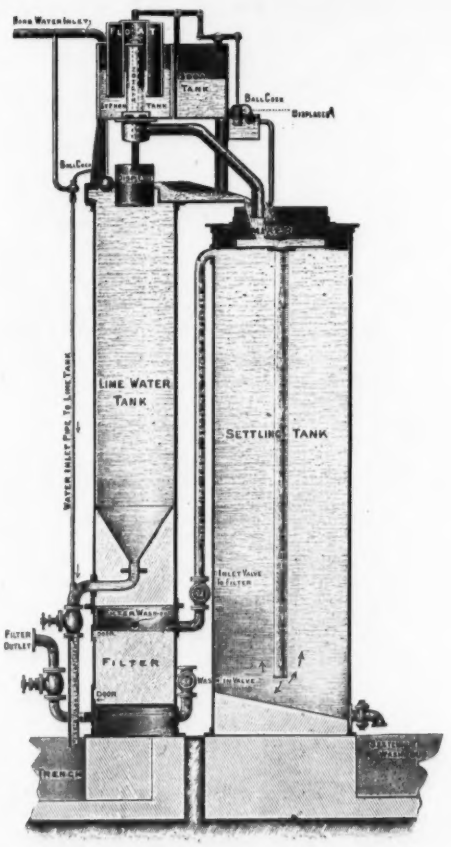


FIG. 2.—CROSS-SECTION OF SOFTENER.

The discharges from the hard water syphon tank, and from the lime and soda tanks, all meet at the same time and at the same place, viz.,

the mixer, thus ensuring an immediate and thorough mixture in their proper proportions.

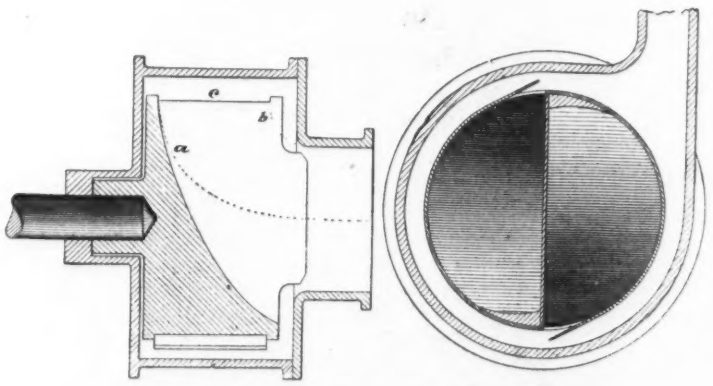
From the mixer the treated water is passed through a down pipe to the bottom of the settling tank, whence it steadily flows upward, leaving in its progress the heaviest of the suspended matters caused by the action of the softening process. From here it passes through the filter, emerging at "filter outlet" soft and bright. The filter is cleaned without the removal of the filtering medium. The lime tank is recharged with lime daily, and the spent lime drawn off. The total attention required in the case of medium sized plants is stated to be that of one man for an hour once in twelve hours.

The type of water softener here described is known as the "Criton." It is manufactured by the Pulsometer Engineering Company, Ltd., Reading, England.

The Design of Centrifugal Pumps.

There are given below a few facts relating to the elements which have been considered in the design of a centrifugal pump which has shown the remarkable performance of producing a vacuum of 28.75 in. when the barometer stood at 29.56.

In studying the reactions taking place, it is found that the volume of water flowing through any centrifugal pump is acted upon continuously by centrifugal force and by atmospheric pressure. Centrifugal force at all times acts radially and perpendicularly to the axis of rotation of the impeller. Atmospheric pressure in the case of an axially disposed inlet pump, obviously tends to maintain the liquid in a straight line in continuation of the direction in which it enters the pump—in a direction parallel with the axis of the pump. The path which the liquid will actually pursue is dependent upon at least three considerations, namely: the centrifugal force acting upon it, the atmospheric pressure acting upon it, and the extent to which it is controlled, guided and deflected by the construction of the passages through the pump. The construction of the pump should be such as to permit the liquid to take that path which it naturally tends to take under the combined action of the centrifugal force and the atmospheric pressure, modified only by considerations



FIGS. 1 AND 2.—SECTIONS OF CENTRIFUGAL PUMP.

of practical construction. In other words, whatever power is consumed in deflecting and guiding the liquid out of its natural course is power consumed in impact, and is power wasted.

It is obvious that all parts of the inflowing column of water will not be equally affected by centrifugal force. That liquid which enters at the exact center of the inlet will pass into the influence of the impelling blade at a point where the latter has practically no movement. Accordingly, there is practically no centrifugal force imparted to the column along its axial line, and the liquid might flow on indefinitely in a straight line were it not for the two considerations that it is a part of a body or column of liquid which as a whole is deflected, and that because the blade of the impeller has an appreciable thickness, the liquid can never enter exactly in the axis of the pump. It is evident, however, that this liquid which enters substantially at the axis of the pump will be deflected radially very slowly at first, and with increasing force and abruptness as it departs from the axis and comes into the influence of the more and more rapidly moving parts of the impeller blade.

That liquid which enters at the periphery of the inflowing column will obviously come immediately into the influence of a part of the impelling blade traveling at a relatively high speed, since it is comparatively remote from the axis of rotation. Accordingly, this peripheral portion of the column will be deflected much more abruptly, and it will not be long in acquiring a direction of flow substantially perpendicular to the axis of the pump.

In Fig. 1, which is a correct axial sectional view on a reduced

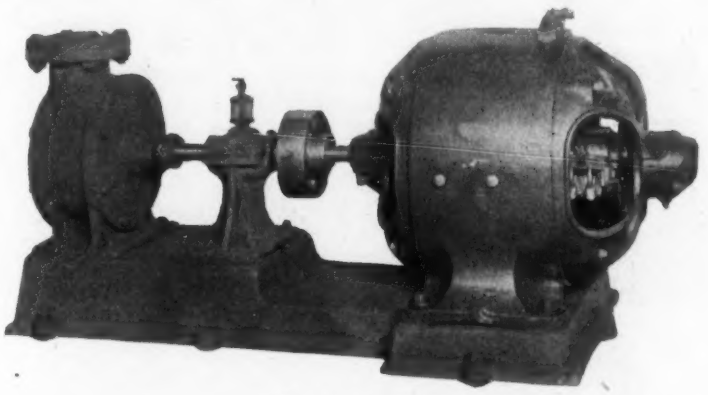


FIG. 3.—MOTOR-DRIVEN SINGLE-STAGE PUMP.

scale of a Brooks 4-in. pump having a 5-in. inlet, these resultant lines of force (the extreme inner and outer) are indicated by the lines *a* and *b* which have been plotted from accurate data obtained by an unlimited number of tests. It will be seen that these two resultants are divergent at all points; it will also be seen that the inner curve *a* is a much flatter curve, and that both of the curves are more or less parabolic; it will further be seen that these two extremes coincide with the extreme ends of the outlet slots *c* of the hollow piston.

It will be seen therefore that in the pump illustrated there is no impact of the liquid or guiding of the latter whatever during its passage through the impeller.

Since it is the very purpose of the pump to accelerate the motion of the liquid passing through it, it follows that the combined area of outlet from the hollow piston must be substantially less than the total inlet area, or else (since water is a practically non-expansive fluid) the delivery outlets will not be kept filled and the pump will be inefficient both because the piston outlets are defectively sealed, and because there would be more or less churning or eddying of the liquid. In other words, if the column of liquid entering a pump be considered as divided into two columns, then each of these columns will be of increasing diameter in cross-section in one direction, but of decreasing diameter in cross-section in the other direction.

It will be readily seen that the resultant lines of force, *a* and *b*, depend upon another factor, namely, the speed of revolution. This means that a given design of pump must be operated at a given speed if its greatest efficiency is to be secured.

There are other considerations, and important ones, which contribute both to the efficiency and to the lifting power of the Brooks pump. By reference to Fig. 2 it will be seen that a lip overhangs each of the two outlets of the piston. These lips are directed tangentially and rearwardly. They perform two functions which contribute to the efficiency of the pump, viz.: they serve as guards which keep the outflowing columns of liquid from impinging directly against the annular body of the liquid between the casing and the piston, thus minimizing the eddying, and they to some extent impel the liquid onward toward the casing outlet. It is evident that throughout nearly the entire circumference of the annular space between the casing and the piston, the liquid is flowing onwardly or in the same direction with the piston movement. Clearly the minimizing of the eddying will decrease the losses, and this the lips effect by confining the disturbance due to the overflow to the space immediately next to and surrounding the piston.

In the rapid rotation of the piston, the lips obviously tend to create a vacuum in the rear or lee of each, and this creates an effective drag on the liquid just delivered, pulling it along in the direction of the general flow.

On Nov. 30th, 1904, a test was made at the St. Louis Exposition in which the Brooks 2-inch single-stage pump worked successfully on

an actual suction of 30 feet and against a pressure of 25 pounds (equivalent to about 57.6 feet); this was interesting from the fact that it actually raised the water through a height of 30 feet on the suction side—a severe test for any pump of the direct type. The test was witnessed by a number of prominent engineers.

The manufacturer of the Brooks pump is the Dayton Hydraulic Machinery Company, of Dayton, Ohio, with a New York office at 133 Liberty Street.

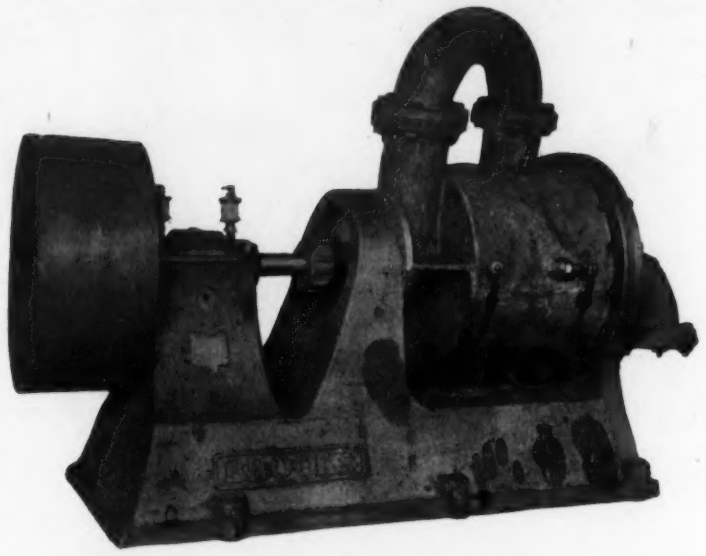


FIG. 4.—SLOW-SPEED TWO-STAGE PUMP.

Guy Anchors.

The accompanying illustrations show the method of installing Stombaugh guy anchors made by W. N. Matthews & Brother, of 227 North Second Street, St. Louis. The smaller sizes of these anchors are shown in Figs. 1 and 2. Fig. 1 illustrates the rodless anchor. A piece of galvanized-iron cable or wire, 7 or 8 ft. long, is attached to the eye of a rodless anchor and then passed through the hollow pipe of the installing wrench. The anchor is then keyed to the wrench and the wire drawn tight and a clamp set flush with the crossbar of the wrench, as illustrated in Fig. 1. The rodless anchors are only made in 5 and 6 in. Fig. 3 illustrates the 5 and 6-in. anchors with rod.

FIG. 1.—RODLESS GUY ANCHOR.

The new feature of these anchors is that the pipe of the wrench is now being made longer than formerly, and allows about 1½ to 2 in. of the eye to project beyond the crossbar. A metal or wooden wedge is driven firmly into the eye, as shown in Fig. 2. The clamp on the strand and the wedge in the eye prevent the wrench from slipping off the key from the torsional strain while the anchor is being set. The anchor must always be bored into the ground at the angle at which the guy wire is to run. When the proper depth is reached the wrench is pulled out and the guy cable from the pole is attached to the end of the cable coming from the anchor, or to the eye of the anchor left projecting from the ground.

FIG. 2.—GUY ANCHOR.

FIG. 3.—GUY ANCHOR WITH ROD.

Fig. 3 shows the method of installing the larger sized anchors, those from 8 to 12 in. in diameter. These sizes are provided with bars sufficiently heavy to withstand the boring strain and have large eyes at the end through which a bar is passed to serve as a crank to bore them in. It is obvious that lines that have been strengthened and braced in this manner have a maximum ability to stand strain: and such has proved to be the case in every instance.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Improvement is generally reported in trade, although progress is hampered by some inflation of prices for the raw materials of textile and footwear industries. Confidence expands as the crops are secured. Weather conditions have been favorable for retail distribution, reduced stocks in the hands of dealers being reflected in enlarged wholesale, and jobbing demands. Evidences of faith in the future are increasing, more disposition being shown to provide for requirements beyond immediate consumption. The industrial situation is in striking contrast to conditions prevailing a year ago, when there was much idleness, both on account of quiet trade and of labor controversies. Complete returns now available for the leading departments indicate that the first half of 1905 made a better comparison with the corresponding six months of last year than even the most sanguine estimate, which naturally increases optimism regarding business during the second half. The tonnage movement on the country's railways is very heavy for this season of the year, the rather later movement of winter wheat being made up for by the increased volume now reported. The general tendency has been toward a further slight improvement in collections. The iron trade shows some quietness. Foundry iron is less active at the east, but the lull is as much due to the advance of 50 to 75 cents per ton as to any other reason. Southern iron has further strengthened, and raw materials for iron manufacture are in more active request. Sales of structural materials, rails and other finished products are heavy for this season of the year. Coke is more in demand and rather firmer. Bituminous coal is dull and still easy in price, but recent advances in anthracite are rigidly adhered to. Other industries show considerable activity. The summer shutdown of glass factories will be the shortest reported in many years. Building is more active throughout the country, confirming the most optimistic predictions made earlier in the season. The total number of business failures during the week ending July 27, as reported by *Bradstreet's* was 197, against 165 the week previous and 174 the corresponding week last year. Copper closed at 15¼ to 15⅜ for Lake and electrolytic, and 14⅞ for casting stock.

CANADIAN WHITE COMPANY.—Another sign of the activities in the engineering field associated with the name of J. G. White is to be seen in the formation of the Canadian White Company, Sovereign Bank Building, Montreal, to work in close affiliation with the other White organizations that begirdle the globe, and which have done some of the largest electrical plants now in operation for light, traction and transmission. It will do a general contracting and engineering business. Mr. H. P. Douglas, formerly vice-president and general manager of the Canadian Otis Elevator Co., will be treasurer of the concern; Mr. H. C. Hitch, formerly with the Thompson-Starrett Co., will be the superintendent of building construction. The Canadian White Company, Limited, will undertake any civil, mechanical, electrical, hydraulic and building work. It will be fully equipped to handle large construction contracts for steam or electric railways, and will be prepared to design, build, equip and operate electric lighting plants and power installations, gas works, water supply, sewage systems, piers, docks, harbor works, office buildings, apartment houses, hotels, etc. The company does not manufacture machinery or apparatus, nor is it interested in any manufacturing agencies, but purchases from the leading manufacturers such machinery and materials as are required in carrying out its contracts.

THE PELTON WATER WHEEL COMPANY, of San Francisco and New York, has just closed contract for a water wheel installation for D. J. Aguirre & Co., of Tepic, Mexico. The head available is 175 feet and the plant consists of two Pelton wheel units of 700-hp capacity, each direct connected to General Electric generators, 300 r.p.m.; also two Pelton wheel units for driving exciters. Sturgess oil type governors will be used. Pelton wheels are universally employed at the sugar plantation of Aguirre & Co., there being six wheels at present employed for driving heavy sugar rolls by means of direct connection, machine shops, electric lighting, etc. It is worthy of note that the export trade in Pelton wheels has largely increased in the past year, this company having made large shipments to Central and South America, Japan, and the Strait Settlements. Indications for further increase in these directions are most favorable.

AMERICAN EXPORTS AND IMPORTS.—Below are given the statistics of the year ending June of American export and import trade—the best year this country has ever had in foreign commerce:

Twelve months imports—articles:	1905.	1904.
Food and live animals	$273,629,853	$233,211,398
In a crude condition	386,459,421	321,500,006
Wholly or partially manufactured	143,152,036	136,598,793
Manufactured ready for consumption	165,886,082	167,537,191
Luxuries, etc.	148,385,237	132,239,983
Total imports	$1,117,512,629	$991,087,371
Twelve months exports—products of:		
Agriculture	$821,074,439	$853,693,133
Manufactures	543,620,297	452,445,629
Mining	50,646,447	45,917,624
Forest	62,098,899	68,884,310
Fisheries	7,318,705	8,576,790
Miscellaneous	6,985,908	5,661,531
Total domestic exports	$1,491,744,695	$1,435,179,017
Re-exports	26,817,025	25,648,254
Total exports	$1,518,561,720	$1,460,827,271

EQUIPMENT FOR APARTMENT HOUSE.—A 12-story apartment house is to be built at the northwest corner of 70th Street and Central Park West, New York, in which will be installed a complete steam, electric and refrigerating equipment. The Vailima Realty Co., of 648 Broadway, is the owner; Mr. Robert T. Lyons, 31 Union Square, is the architect. Mr. Percival Robert Moses, 320-322 Fifth Avenue, has been retained as consulting engineer. There will be three horizontal tubular boilers of 100 horsepower capacity each. The three engines will be of simple automatic high-speed horizontal type. Two will be 13x12, and one 12x12 in. They will operate at about 300 r.p.m. The generators will be direct coupled, direct current, compound wound multipolar, 115 volts. There will also be an extensive storage battery equipment.

ADVANCE IN COPPER.—The stiffening in the price of copper has resulted in the expected advance. All the principal copper selling agencies, including the United Metals Selling Co., have advanced their prices ⅛c. per pound. Lake copper is now selling at 15⅜c.; electrolytic at 15¼c. The tone of the market is very firm and demand strong at the higher prices. A large copper producer says that the strength of the stocks of the various copper companies is due largely to the increased demand for the metal. "The rise in the price of the metal," said he, "is free from speculation, as the big producers believe that a sharp upward movement would only tend to disturb conditions that are satisfactory to consumer and producer alike."

WESTINGHOUSE ORDERS.—Orders have been received by the Westinghouse Electric & Mfg. Company from Nelson Morris & Company for nineteen type CCL induction motors varying in sizes from 5 to 50 horsepower and totaling 410 horsepower, and for eight motors of the same type from the Decatur Car Wheel & Mfg. Company, Birmingham, Ala. These are the latest design of induction motors which have been built and have been just recently placed on the market. On the same day an order was entered from the Illinois Steel Company for eighty direct-current motors having an aggregate capacity of 3,920 horse-power. These motors are all of the railway type and range from 30 to 75 horsepower.

THE HAWAIIAN ELECTRIC COMPANY, of Honolulu, has contracted for two 1,200-kw, three-phase, 2,200-volt, engine type generators, two 125-kw. exciters and seven 500-kw. oil-insulated self-cooling transformers. The Rumford Falls Power Company of Rumford Falls Me., will install one 550-kw. and one 800-kw. alternating-current generator which will be direct-connected to waterwheels. The order includes two 450-hp variable speed induction motors, and 120 type OD transformers for use on the distributing lines.

NAVY BIDS.—Bids will be received until Aug. 8 at the Bureau of Supplies and Accounts, Navy Dept., Washington, for furnishing at the Navy Yards at Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C. and Norfolk, Va., motors, electrical conductors, cable, brass and steel conduits and fittings; boilers, hydraulic jacks, Pratt & Whitney turret lathes, etc. Address H. T. B. Harris, Palmaster-General, U. S. N.

THE RISDON-ALCOTT TURBINE COMPANY of Mount Holly, N. J., has just shipped to the Cramer Electric Company, Hailey, Idaho, an 800-hp turbine unit, consisting of three wheels on horizontal shafts for setting in a concrete flume. These wheels are to be direct-connected to a Crocker-Wheeler generator for the power plant to be installed by the Cramer Electric Co.

COMPETITION WITH NATIONAL CARBON.—The Cleveland *Plain Dealer* makes the following announcement: "The National Carbon Company will very soon have a competitor with immense financial backing. It developed here yesterday that Rockefeller interests are behind the United States Carbon Company, which will soon be financed with a capitalization close to $1,000,000. For more than a year the United States concern has been closed down. About one month ago, however, the property was bought up by Martin B. Daly, general manager of the East Ohio Gas Company, a well-known Rockefeller corporation. The plant is now being overhauled at an outlay of nearly $100,000. It will be turning out carbon products by September 5. Burton P. Foster, manager of the company, stated that in addition to the plant here branches will be established in the natural gas belts of Ohio and a mammoth organization will be built up rapidly to compete with the National Company. Mr. Daly is now abroad, but will return August 15, and immediately thereafter the financing will be begun. The company will be reorganized and will probably be given a new name among other changes. Mr. Foster admitted that Rockefeller capital is interested in the project, and spoke optimistically of the future of the company about to be formed. He said that one carbon customer has already been secured who will net $100,000 a year to the concern. He also intimated that various lighting plants and electrical concerns will throw enough patronage to the new organization to insure for it great progress. Foster is in charge of the overhauling of the old plant. New machinery is being put in and the old is being repaired. Four new buildings will be erected, and when the changes are all made the plant will cover four acres. At this plant high grade carbon batteries and motor brushes will be turned out, while at the branch plants lower grade carbon will be manufactured. The capacity will be increased as the demands become heavier. Mr. Foster stated that the new company will be maintained as an independent instituion regardless of its backing, and will have the distinction of being the only independent carbon company on American soil. Cleveland will thus be the storm centre of a carbon war, which is not only imminent, but soon to become a reality. Mr. Foster, who is an expert in this line, will have charge of the operation of the plant. The other officers will be chosen from institutions of the highest standing. The fight that will get its impetus here will be carried all over America, and to the shores of countries across the water." The National Carbon Company has a capital of $4,500,000 7 per cent preferred stock and $5,500,000 common stock, on which 1½ per cent has lately been paid semi-annually.

CALIFORNIA POWER.—It is believed in California that the Southern Pacific Railroad is securing power plants. Two large electric power plants at Reno are reported to have changed hands, and there is some speculation in local financial circles as to whether the properties have been taken over by the Southern Pacific Company or the California Gas & Electric Company. The Southern Pacific is being credited with a desire to establish itself in the electric power business on the Truckee River with the idea of generating power for the construction of its proposed tunnel through the Sierras and for the operation of trains after the tunnel is completed. General Manager Calvin states that the tunnel project is at a standstill at present, and that the company has no thought of acquiring any power plants on the Truckee River, which lends credence to the belief that the Martin-De Sabla Company is creating all of the present stir at Reno. Negotiations looking to a consolidation of the interests of the California Gas & Electric Company and the San Francisco Gas & Electric Company are said to be still in progress, and there is talk of the formation of a third company with a capitalization of $60,000,000 for controlling the light and power situation. One theory advanced is that the Southern Pacific and its allied interests will line up for the development of electric power for their own and other uses on one side. On the other, may be the California Gas & Electric Corporation, the Western Pacific (representing the Gould interests), and possibly the Western Power Company of Plumas County, which has an electric power transmission project headed for San Francisco. The San Francisco Gas & Electric Companies and other lighting stocks are strengthened by the general situation.

ELECTROMETALLURGIC PLANT.—A special dispatch of July 27 from St. John, N. B., says: "According to Attorney-General Pugsley, who recently returned from New York, a number of prominent New York capitalists are contemplating the promotion of certain enterprises at Grand Falls, which will involve the expenditure of over $10,000,000. Large deposits of bog iron, or manganese, have recently been discovered in the province, and it is the intention of the promoters to establish at Grand Falls a huge plant in which the ore can be treated by electricity, thus manufacturing ferro-manganese, a very valuable product. The plant will be run by water power, and will have a minimum of 60,000 horse-power, with a maximum of about 300,000. It is intended also to supply Grand Falls and other towns along the St. John River with electric energy for lighting and power purposes; to acquire the International Railway between Campbellton and Grand Falls and operate it by electricity, and to erect pulp and paper mills with a capacity of 600 to 800 tons a day—the largest mills, it is believed, in the world. The operations of the company, if successfully carried out, will give employment to thousands of people, while the industrial development of the St. John Valley will receive an enormous impetus. Although the preliminary expense will be very great—involving, as has been said, an expenditure of $10,000,000—the capitalists interested in the enterprises appear entirely satisfied with the outlook, and feel that the undertaking will offer profitable employment of capital. It is probable that operations will begin during the present year."

PROSPECTS IN HUNGARY.—Mr. Arthur A. Brandt, Technisches Bureau, N. W. 24 Berlin, is opening an office for the representation of American electrical and mechanical firms in Vienna, and sends us the subjoined interesting remarks: "In the ELECTRICAL WORLD AND ENGINEER I observe often the not only interesting, but also very valuable hints and information you are giving the U. S. A. exporters by publishing articles about conditions of trade and industry in foreign countries. One part, however, it occurs to me has up to now not been noticed sufficiently by the American exporters; i.e., the altered conditions of import into Austro-Hungary. As will be known to you, with the beginning of next year the new custom regulations between Germany and Austro-Hungary will begin also. According to this new tariff, most of the German goods will be taxed so high that the present large import from Germany must decrease to ¼-⅓ of the present. The duty for electrical machinery and appliances is then so high that it will be absolutely impossible to import German manufactures in future. The ¾-⅔ of import which Germany loses must consequently be gained by the other countries importing into Austria, and it will be necessary for the American to make all efforts to prevent this new business from going entirely into the hands of the other continental countries. I am convinced that there will be a rapidly growing demand for American goods in Austro-Hungary."

CONTRACTS FOR ELEVATORS.—The Marine Engine & Machine Company, manufacturers of electric elevators, have removed their offices to No. 126 Liberty Street, this city, where they occupy the entire fourth floor. This company has recently secured the following contracts: The Hutchins Building, at southeast corner of 5th Ave. and 39th St., C. P. H. Gilbert, architect, Thompson-Starrett Co., builders, four of their direct-connected, electrically-controlled elevators. The College of the City of New York, George B. Post, architect, Thomas Dwyer, builder, eleven electric elevators. One tandem electric elevator for the building of the New Orleans Railways, Sanderson & Porter, engineers. One electric elevator in the Hartford Building, 17th St. and Union Sq., this city. Two electric elevators for the Pennsylvania Railroad Co., at Long Island City, Westinghouse, Church, Kerr & Co., engineers. One electric elevator for the Willett Realty Co.'s new building at West End Ave. and 82d St., Carlton Strong, architect; and one automatically-controlled residence lift for C. W. Luyster at No. 16 East 67th St.

POWER IN WESTERN PENNSYLVANIA.—The Western Pennsylvania Motor Company is securing right of way for a trolley road from New Castle to Pittsburg by way of Ellwood City, Pa. It is controlled by the Pittsburg capitalists who own the Pennsylvania Power Company, at Ellwood City, Pa., and are building a large steam plant at Ellwood City for light and power. The company has 10 or 15 miles of transmission line erected and is selling all the power it can produce. When the new steam plant is completed it will build large dams on the Connoquenessing River, as it owns both sides for miles. The river has a rapid fall between high, rocky banks, and stone for the dam is procured at low expense. A large hydro-electric system will then be created.

THE MILFORD CONSTRUCTION COMPANY.—Wallace C. Johnson, of Niagara Falls, chief engineer, has closed a contract with James B. Mullen, of Bangor, Me., for constructing its dam and power house. The plant consists of a concrete dam about 1,000 feet long across the Penobscot River, at Oldtown, Me., giving about 25 feet head, and a power house containing twelve 1,000-hp generators direct-connected to water wheels. Hydraulic power has been used at this point for several years. About 3,500 hp is now in use, produced by a wing dam and canal along the west bank of the river. The current generated by the new plant will be transmitted to the city of Bangor, 15 miles away, where a market exists for all that can be thus produced.

TRADE WITH BOLIVIA.—Mr. Benjamin Chabaneix, Calle Commercio, 9, 11 and 15 La Paz, Bolivia, commission and export house established in 1844, wishes to receive catalogues and samples of all classes of merchandise for that country.

THE MOVEMENT FOR RECIPROCITY.—The adoption by several of the principal European nations of retalitaory tariffs for the purpose of excluding American products and manufactures is

operating to rapidly crystallize a movement by important manufacturing, farming and cattle raising interests of this country to promote the negotiation of reciprocity treaties to preserve American export trade from the dangers which threaten it. This movement has sprung up spontaneously in widely separated parts of the country and is spreading over the entire United States with great rapidity. A National Reciprocity Conference has been called to be held in Chicago August 16 and 17. Although this movement was organized principally by live stock breeding interests, the immediate co-operation of many important commercial and manufacturing bodies was tendered. Among the numerous organizations which have adopted resolutions favoring reciprocity and taking action to co-operate in the conference are the Chamber of Commerce of the State of New York, the Merchants' Association of New York, and the Produce Exchange of New York. These organizations are representative in important business and manufacturing interests of the metropolis, as well as a large part of the Eastern States. They will be represented at Chicago by strong committees authorized to voice the sentiment of their constituents in favor of reciprocity.

TELEPHONY IN CUBA.—The Cuban Telephone & Telegraph Co. has closed a contract for a 15,000 line automatic system for Havana to displace the old "Red Telefonica" system formerly owned by a Spanish company. The initial installation will be 5000 lines. The company will soon erect a new building and lay a new conduit and cable system for the new plant and within a year Havana will have a more perfect and modern telephone system than many American cities possess. The cosmopolitan character of Havana's population makes the automatic the only logical system to use there, for it would be necessary for human telephone operators to be linguists in a city of so many nationalities. The Cuban Telephone & Telegraph Co. has also contracted for a 600-line automatic system for the town of Marianao, a suburb of Havana. As already announced, the contracts have been made with the Automatic Electric Co. of America.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull throughout the week, although there was a strong tone. The favorable report of the United States Steel Corporation for the June quarter had a moderately bullish effect on the Steel stocks. Increased attention was paid to various industrial specialties. There was considerable strength in electric and traction securities, the advance being headed by General Electric, which made a net gain of 5¼ points, closing at 179¾, the highest price being 180 and the lowest 172. Westinghouse closed at 168½, a net gain of 1½ points, and Allis-Chalmers common at 18¾ and preferred at 62⅞, these being net advances of 2¾ and 4⅞ points, respectively. Brooklyn Rapid Transit closed at 69⅝, thereby gaining 2⅛ points net, and Metropolitan Street Railway 128, a gain of 2⅞. Interborough Rapid Transit closed at 213½. Other closing quotations and changes are as follows: American Telephone & Telegraph, 139, a loss of ⅝-point; Electric Storage Battery, 82, a loss of ½-point, and Western Union, 92⅜, a net gain of ⅜. The curb market was generally strong, with sharp advances in Chicago Subway and Interborough Rapid Transit. The volume of business was nearly double that of the previous week. The advances were largely sympathetic with those on the Stock Exchange. Following are the closing quotations of August 1:

NEW YORK

	July 25	Aug. 1		July 25	Aug.
Allis-Chalmers Co.	15¼	18	Electric Vehicle pfd.	26	25
Allis-Chalmers Co. pfd.	55¼	62	General Electric	173¼	179
American Tel. & Cable	90	90	Hudson River Tel.	..	..
American Tel. & Tel.	139	137	Interborough Rap Tran.	205	215
American Dist. Tel.	29	29	Metropolitan St. Ry.	125⅝	127⅛
Brooklyn Rapid Transit	67¾	68⅞	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	20	20	Western Union Tel.	93¼	93
Electric Boat pfd.	60	60	Westinghouse com.	165⅛	165
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..
Electric Vehicle	18	18			

BOSTON

	July 25	Aug. 1		July 18	Aug. 1
American Tel. & Tel	139	138⅛	Western Tel. & Tel. pfd.	*99	*99
Cumberland Telephone	117	117¼	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	243	244	New England Telephone	*138	135
General Electric	173	180	Mass. Elec. Ry.	18	17⅛
Western Tel. & Tel.	18	18	Mass. Elec. Ry. pfd.	62¼	61

PHILADELPHIA

	July 25	Aug. 1		July 25	Aug. 1
American Railways	51	51	Phila. Traction	89⅞	..
Elec. Storage Battery	81	82	Phila. Electric	8¾	8⅝
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	27¼	27⅜
Elec. Co. of America	11¼	11⅛			

CHICAGO

	July 25	Aug. 1		July 25	Aug. 1
Central Union Tel.	..	..	National Carbon pfd.	117⅛	117
Chicago Edison	158		Metropolitan Elev. com.	23⅞	24
Chicago City Ry.	..	*196	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	63	63			

* Asked.

TELEPHONY IN ENGLAND.—The report of the National Telephone Company of Great Britain for the year ending June 30 compares as follows with the two preceding years:

	1905.	1904.	1903.
Gross	$10,601,065	$9,629,300	$8,812,550
Net	3,512,465	3,272,825	3,063,090
Charges	919,880	751,430	674,300
Dividends	1,489,165	1,480,165	1,464,585
Surplus	1,103,420	1,032,230	924,205
Reserve	1,125,000	1,250,000	950,000
Total Reserve	48,495	46,850	29,155

There has been a growth in gross earnings since 1895 from $3,875,870 to $10,601,605. A sale of the company is to be made at the end of 1911 to the British post office, subject to approval by Parliament, at a fair market value.

KANSAS CITY RAILWAY & LIGHT COMPANY.—The Kansas City Railway & Light Company makes the following report for the year ended May 31:

	1905.	1904.	Changes.
Gross	$4,449,134	$3,878,358	Inc. $570,776
Expenses	2,235,260	2,090,172	Inc. 145,088
Net	$2,213,874	$1,788,186	Inc. $425,688
Other income	16,588	5,689	Inc. 10,899
Total income	$2,230,462	$1,793,875	Inc. $436,587
Deductions	1,501,862	1,371,586	Inc. 130,276
Surplus	$728,600	$422,289	Inc. $306,311

DIVIDENDS.—The Consolidated Car Heating Company's dividend, payable on August 1, was 1½ per cent and 1 per cent extra. The dividend in February was 1½ per cent. The stock is thus placed upon a 4 per cent basis for 1905. The dividend in 1904 was 6 per cent and that of 1903 was 7 per cent. The highest ever paid by the company was 7½ per cent in 1900, and the lowest was 1 per cent in 1895. The decrease in the dividend for the present year is explained by the fact that the company has been increasing its plant. The directors of the New England Telephone & Telegraph Company have declared a dividend of $1.50 per share, payable August 15, to stockholders of record July 31.

HAMPSHIRE & WORCESTER STREET RAILWAY.—The stockholders and creditors of the Hampshire & Worcester (Mass.) Street Railway Company have received notice of the petition of Receiver G. S. Taft, of Worcester, for leave to sell the property of the company at public auction. The petition states that the property is mortgaged to the American Loan & Trust Company of Boston for $400,000 to secure the payment of principal and interest of certain bonds, of which $135,000 at par are outstanding. A hearing will be held in the Supreme Court, first equity division, in Boston, this month, to show cause why the petition should not be granted.

NEW ENGLAND TELEPHONE & TELEGRAPH.—The directors of the New England Telephone & Telegraph Company have voted to increase the capital stock of the company 30,860 shares for the purpose of providing funds for the payment of its third series of bonds due in 1906 for the extension of the property and business the company. The new stock will be issued at par ($100) to stockholders of record at the close of business August 19, in the proportion of one new share for every eight shares now outstanding. Subscriptions close September 16.

WEST INDIA ELECTRIC COMPANY, LTD.—The West India Electric Company, Ltd., of Kingston, Jamaica, has issued a statement for the year ended December 31, 1904. It compares as follows:

	1904.	1903.	1902.
Passengers carried	3,489,625	3,692,109	3,505,306
Gross	$131,166	$138,724	$129,810
Net	63,248	75,022	64,436
Surplus over charges	28,131	39,532	29,265

This system is equipped with American apparatus.

PORTLAND, ORE., GENERAL ELECTRIC MORTGAGE.—Stockholders of the Portland General Electric Company at a special meeting voted to authorize the directors to make a new mortgage to include all the property of the company for an issue of $10,000,000 of bonds, $4,000,000 of which will be sold at once to refund outstanding indebtedness at a lower interest rate, pay for the new steam plant erected at the foot of Twenty-first Street, and provide a surplus in the treasury for improvements that are already planned.

PHILADELPHIA BELL TELEPHONE.—The Bell Telephone Company of Philadelphia has passed the 100,000 mark, the number of its telephones and those of the Delaware & Atlantic Company having increased 17,503 since January 1. The stock subscription rights have been bid up to 5½. Nearly all of the $2,000,000 new stock is being subscribed by the stockholders of the company.

SHREVEPORT LIGHTING COMPANY.—The Shreveport Gas, Electric Light & Power Company has placed on record a mortgage in favor of the American Trust and Savings Bank of Chicago for $1,000,000. The bonds to be issued under this mortgage will be used to retire outstanding bonds and to make improvements in the property.

General News of the Week

The Telephone.

MAGNOLIA, ARK.—The Magnolia Telephone Company has been formed with a capital stock of $15,000, by R. L. Moore, president, and Gus Kohn, secretary.

FOWLER, CAL.—The Fowler Independent Telephone Company has been formed by W. T. Crawford, P. W. Hastie, and others. Capital, $75,000.

WASHINGTON, D. C.—The Cumberland Telephone & Telegraph Company has issued a statement showing a total of 130,582 subscribers, June 30, 1905.

ATLANTA, GA.—The Southern Bell Telephone & Telegraph Company is having plans prepared for a five-story building of steel construction. It will have a capacity for 25,000 telephones.

GALESBURG, ILL.—The Galesburg Union Telephone Company has increased its capital stock to $250,000.

SPARTA ILL.—Five applications have been filed by Messrs. J. M. Jenkins, George K. Kobusch, Judge J. C. McCoffy and H. B. Hawes, all of St. Louis, for franchises for telephone, electric light, gas service, water works and a trolley car system. Should the franchises be granted, it is proposed to run a suburban line to Coulterville, 7 miles distant.

BRAZIL, IND.—The Central Union Telephone Company has moved into its new exchange.

HUNTINGTON, IND.—Plans are forming for an independent telephone system in this city, to replace the United Telephone Company, which was recently absorbed by the Bell Company.

OAKDALE, IND.—The Oakdale Light, Heat & Power Company has incorporated to build a new plant. The capital stock is $50,000. R. H. Bauslog, A. N. Dukes and R. A. Edwards are directors.

TERRE HAUTE, IND.—The Central Union Telephone Company is asking for the right to put its wires underground. It offers to grant the city the free use of one duct in each of the conduits for fire and police alarms.

BROAD RIPPLE, IND.—The Central Union Telephone Company has opened a new exchange in this place. New country lines are also being built in all directions. The new exchange board has a capacity for about 150 telephones.

FORT RITTER, IND.—The Tri-County Fort Ritter Telephone Company has incorporated to build an exchange in Fort Ritter. The capital stock is $5,000. The directors are H. S. Dixon, W. P. Holland, J. P. Allen and W. H. Reed.

NORTH MANCHESTER, IND.—Application has been made for the appointment of a receiver for the North Manchester Telephone Company. The application is made by the minority stockholders, who claim that the majority stockholder is using up the revenue in salaries and mismanagement.

LEOPOLD, IND.—A new telephone company, to be known as the Leopold & Reno Telephone Company, has been organized here. The company has leased the Leopold and Branchville line from the Cumberland company. A. J. Meunier, Dr. Tayler, James Ward and J. J. Jennett are directors.

LEBANON, IND.—A representative of the Central Union Telephone Company worked a week soliciting the privilege of placing telephones in residences and business houses for his company with the agreement that the service should be free until 300 telephones had been contracted for. He finally gave up the task, the citizens being opposed to a second system. The independents have everything their own way in Lebanon.

DAVENPORT, IA.—The Richland Telephone Company has increased its capital stock to $20,000.

EARLHAM, IA.—The Adams Township Mutual Telephone Company has been organized. Capital, $2,000.

MALVERN, IA.—The Mills County Telephone Company has been chartered by M. W. Sells and others. Capital, $50,000.

EXIRA, IA.—The Wakefield & Case County Telephone Company has been formed. Capital, $2,000. Incorporated by A. F. Anderson, president; J. C. B. Anderson, secretary.

JOHNSON, IA.—Application has been made for a receiver for the Johnson County Telephone Company, operating in Johnson and adjoining counties in Iowa, with a capital of $50,000. The application states that the company was organized in 1901, that no dividends have been paid, and that its affairs have been grossly mismanaged.

MUSKOGEE, I. T.—The Pioneer Telegraph & Telephone Company is just completing one of the most modern plants in the Southwest at a cost of about $50,000. The company erected its own building, and is installing new apparatus throughout.

SULLIVAN, KY.—The Sullivan Telephone Company has been incorporated by several citizens of this place.

LOUISVILLE, KY.—The Home Telephone Company has purchased a franchise for telephone system in Pewee Valley. The franchise was sold by the Board of Trustees of Pewee Valley, and purchased by D. H. French for the company.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company will erect an addition to its exchange on Madison avenue, near Robert street, and will install switchboards, increasing its capacity to 12,000 telephones. The switchboards in the Gilmor exchange will also be increased 12,000 capacity.

GLADWIN, MICH.—The Gladwin County Telephone Company has been organized to operate a line 11 miles long. The officers are: President, Fred Powell; secretary, H. L. Dow; treasurer, William Neely. These, with L. S. David and Guy E. Smith, comprise the board of directors.

NEW RICHLAND, MINN.—H. Jaehning has sold the exchange here to Capt. Milo Hodgkins.

JERSEY CITY, N. J.—The United Pay Station Telephone Company has been chartered with a capital stock of $50,000. Incorporated by H. O. Coughlan and Thomas F. Barrett.

PATERSON, N. J.—At the annual meeting of the Paterson, Passaic and Suburban Telephone Company officers were elected as follows: H. R. Swartz, president; George A. Post, first vice-president; W. S. Hancock, second vice-president; Barker Gummere, Jr., treasurer; J. W. Lindsay, secretary; Wayne Dumont, counsel; F. A. Demarest, general superintendent.

TRENTON, N. J.—A receiver has been appointed for the State Telephone Company of New Jersey upon the application of two bondholders, owning $24,000 and $5,000 respectively, of bonds on which the interest has defaulted. The company owns a pole line from Trenton to Jersey City, Newark, Elizabeth, Hopewell, Somerville and other points, but it is reported that the central office can not be located, nor can any of the officers be found.

LYONS, N. Y.—The Wayne-Monroe Telephone Company has increased its capital stock from $100,000 to $200,000.

BUFFALO, N. Y.—A receiver has been appointed for the Orr Telephone Co., capitalized at $3,000,000 and organized in Arizona, but having its headquarters in Buffalo, N. Y.

WATERVLIET, N. Y.—Permission has been granted the Hudson River Telephone Company to place its wires underground. The company agrees to furnish seven telephones free, to be used by the city authorities.

MARIETTA, OHIO.—The Lowell Farmers' Telephone Company has been formed with a capital of $10,000 by John Buck and Chas. Schimmel.

CLINTON, OHIO.—The Clinton Bell Telephone Company has been formed by J. A. Smith, L. N. Oberlin, J. G. Hyde, Edward Shondel, and H. F. Lerfass.

LIMA, OHIO.—The Council has passed the Central Union telephone franchise calling for the use of certain streets and alleys for the construction of conduits.

CHAGRIN FALLS, OHIO.—The Home Telephone Company has been incorporated by T. P. Ryan, W. R. Nutt, H. J. Brown, J. T. Daniels and James Niven. Capital, $250,000.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has elected the following officers: President, Dr. J. A. Chesney; vice-president, Benj. Sherer; secretary and treasurer, J. C. F. Hull.

KENTON, OHIO.—The bondholders of the Orange (Texas) Telephone Company at a recent meeting held in Kenton, O., appointed a finance committee and a bondholders' committee to effect a complete reorganization of the company.

NEW CASTLE, PA.—The Speechly Telephone Company has been taken over by the People's Telephone Company of Butler.

DOYLESTOWN, PA.—All the lines and telephones and telegraph franchise leaseholds and all other property of the Standard Telephone & Telegraph Company will be sold at public auction Aug. 12, by order of court.

BATESBURG, S. C.—The Batesburg Telephone Company has increased its capital stock from $500 to $2,000.

PIERRE, S. D.—Articles of incorporation have been filed here for the Gary Telephone Company at Gary, with a capital of $10,000. The incorporators are H. Bassett, J. H. Greene, W. F. Gordon, T. M. Anthony, M. D. Griffing, E. B. Huffman and O. P. Vober.

LICK CREEK, TENN.—The Lick Creek Telephone Company, of Benton county, has been incorporated, with $500 capital, by I. N. Hull and others.

CHATTANOOGA, TENN.—An ordinance has been passed granting a franchise to the East Tennessee Telephone Company to construct conduits through the city streets. The city will have supervision of conduits.

BEEVILLE, TEX.—The rural telephone system at Beeville, Tex., has been sold at sheriff's sale.

MANTELL, TEX.—The Citizens' Telephone Company has been formed. Capital, $1,000. The incorporators are A. S. Baylor and T. S. Southerland, and others, of this place.

KERRVILLE, TEX.—The Kerrville Telephone Exchange Company has been sold to the Texas Telephone & Telegraph Company of San Antonio.

CORPUS CHRISTI, TEX.—The long distance telephone is to be extended from Corpus Christi to Rockport, and a local exchange established at Rockport by the Southwestern company. The Rockport connection will be ready about Oct. 1.

CRAIGSVILLE, VA.—The Craigsville & Bell's Valley Mutual Telephone Company has been formed, with J. B. Tuttle, president; D. Kunkle, vice-president; L. E. Hicks, secretary and treasurer. The capital is $5,000.

WINCHESTER, VA.—The American Telephone Association, Limited, has been incorporated by W. C. Graichen, president; R. T. Barton, secretary and treasurer, both of Winchester, Va. Capital stock: Maximum, $2,500; minimum, $300.

MADISON, WIS.—A telephone company has been formed here by three local men to build a line from Hudson to Milwaukee and between Stillwater and St. Paul. Capital, $100,000. A. S. Zimmerman and Rufus B. Smith are interested in the company.

BENWOOD, W. VA.—The National Telephone Company will shortly begin extensive improvements on its system at Benwood and through the interior of Marshall County.

Electric Light and Power.

LUXORA, ARK.—The Town Council has granted Wm. and C. B. Wood a franchise for an electric light plant.

JONESBORO, ARK.—The Jonesboro Improvement District will expend about $220,000 for the purchase of the water and lighting plants, and the construction of a sewerage system.

SAN FRANCISCO, CAL.—Mr. Drew R. Oliver, Flood Building, this city, is the promoter of the Pescadero Water & Electric Company, which has been incorporated in San Francisco, by G. W. Kaiser, J. R. Kenny, H. N. Baggs, B. F. Kohlberg and R. H. Goodwin. The capital stock is $150,000, in shares of $1 each. Pescadero will derive considerable benefit from the construction of the Ocean Shore Railway, between San Francisco and Santa Cruz.

SEYMOUR, CONN.—The Seymour Electric Light Company has received authority to increase its capital stock to $100,000.

HARTFORD, CONN.—The Eastern Connecticut Electric Power Company has received the sanction of the legislature to acquire other corporations in Windham and New London counties.

WASHINGTON, D. C.—Bids will be received August 28 at the office of the District Commissioners for furnishing and erecting switchboards, tablet boards and cabinets for the electric plant at the sewage pumping station.

PENSACOLA, FLA.—Bids will be received until August 8 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Pensacola navy yard electrical supplies, cable, telephone wire, etc. Address, H. T. B. Harris, paymaster general.

CORDELIA, GA.—John P. Emerson is preparing plans for an electric light system for Cordelia and other places.

COCHRAN, GA.—The citizens, on July 18, voted to issue $17,000 bonds for electric lights and new water mains.

THOMASVILLE, GA.—The City Council has granted the Municipal Investment Co., of Chicago, Ill., and Columbus, Ga., a franchise for an electric light plant.

FORT GAINES GA.—The Interstate Water Works & Construction Co., of Washington, D. C., which recently secured a franchise for water works and an electric light plant at Ft. Gaines, expects shortly to take bids for the construction of several water works and electric light plants.

FREEPORT, ILL.—The power and light company's plant has been destroyed by fire, entailing a loss of $100,000.

DIVERNON, ILL.—The contract for constructing an electric light plant has been awarded to the Fort Wayne Electric Works for $7,672.

WAUKEGAN, ILL.—The City Council has authorized H. Thacker, city clerk, to procure bids for furnishing 200 5-amp. arc lamps for street lighting, on a three, five or ten-year contract, the bids to be presented to Council at its first regular meeting in August.

NEWPORT, IND.—The town trustees have granted E. E. Sayler, of Saybrook, Ill., a franchise to install an electric light plant at Newport.

OAKDALE, IND.—The Oakdale Light, Heat & Power Company has been incorporated at Peru, Ind., with $50,000 capital stock, by R. H. Bauslog, A. N. Dukes and R. A. Edwards.

NORTH MANCHESTER, IND.—Dr. D. Ginther and others have secured a franchise from the city of North Manchester, Ind., for light, heat and power. The new company proposes to develop the water power at Laketon, five miles distant.

NORTH MANCHESTER, IND.—Messrs. Estep, Gunther and others have been granted a franchise by the city council to establish an electric light, heat and power system in this city. The new company will erect a modern plant and utilize the water power at Laketon, five miles away. There is an electric light company here which has a franchise running for eight years.

CLAREMORE, IND. TER.—The Claremore Light & Power Co. has been incorporated, with a capital of $25,000. The incorporators are J. M. Bayless, F. A. Neilson, W. W. Bryan, and others.

SUMNER, IA.—L. L. Stewart has secured a franchise for an electric light and power plant.

WICHITA, KAN.—The Wichita Railroad & Light Co. has secured the contract for furnishing 271 460-watt arc lights for five years, at an annual cost of $14,454. The lights will burn until 1 o'clock. The company will furnish additional lights at $66 per light per year.

RUSSELL, KY.—Bids will be received until Aug. 15 for the construction of an electric light plant at Russell, at a probable cost of $5,000.

SOMERSET, KY.—Dr. W. Godfrey Hunter has purchased the plant of the Somerset Water Works Co. and is now negotiating for the electric light plant and electric street railway franchise.

MARKSVILLE, LA.—Bids will be received until Aug. 24 by the Mayor and Board of Aldermen for constructing a system of water works and electric light. Ira W. Sylvester, Alexandria, La., is the engineer. C. Ashton Smith is mayor.

ANNAPOLIS, MD.—The Maryland Heat, Power & Light Co. will expend about $40,000 in improvements. Howard E. Crook is president.

BALTIMORE, MD.—Architects are preparing plans for a power house to be erected at Westport, for the United Electric Light & Power Co.

ATTLEBORO, MASS.—The gas commissioners have authorized the Attleboro Steam & Electric Co. to issue 450 additional shares of capital stock at $100 per share to pay for additions to plant subsequent to May 1, 1905.

NEW BOSTON, MASS.—Engineer H. F. Keith, of Mt. Washington, Mass., is here to make surveys to ascertain the cost of an electric power plant. The company proposes to sell and transmit electric power to various cities in Massachusetts and Connecticut.

AUBURN, MASS.—A 350-horse-power alternating current power and lighting plant is to be installed at the Ettrick mills at Stoneville in Auburn. Thompson & Gallagher of Worcester are the engineers. The Stanley-G. I. Electric Manufacturing Company, of Pittsfield, will furnish the electrical apparatus, and the American Engine Company, of Bound Brook, N. J., will install the compound condensing engine.

TURNERS FALLS, MASS.—The Franklin Electric Light Company at the annual meeting elected these officers: President, Capt. J. F. Bartlett; treasurer, W. C. D. Thomas; secretary, E. I. Cassidy; directors, the above and W. D. Russell, Porter Farwell, C. W. Schuler and C. W. Hazelton. The company will at once prepare for a considerable extension of its business, which is made possible by its getting power from the plant of the Turners Falls Company.

SAGINAW, MICH.—The Bartlett Illuminating Co. has secured the contract for lighting the city for five years, at $60 per light per year.

HOUGHTON, MICH.—The Superior Construction Company, of Houghton, is preparing plans and specifications for the proposed municipal lighting plant at L'Anse.

ESCANABA, MICH.—The Board of Public Works has petitioned Council for an appropriation of $14,000 to purchase additional machinery for the electric light plant.

BAY CITY, MICH.—The Thorne Electric Company has been awarded a contract to install a complete lighting system, including street and commercial lights, in Tawas City.

ANN ARBOR, MICH.—Mayor Hamilton has vetoed the five-year contract of the City Council with the Washtenaw Light & Power Company for 150 street lights at a cost of $63 per light. The Mayor believes that a combination system of electricity and gas will give a superior all-night service, rather than electricity alone.

SAGINAW, MICH.—George Delby, of Saginaw, is interested in a project to generate power from Rifle River near Standish, to be used for lighting and traction purposes in Saginaw, Bay City and other cities.

MANISTEE, MICH.—J. J. Hubble has completed a survey for the purpose of damming the Manistee River near Sherman, for the development of water power. The dam and power house are to cost $150,000. Eastern capital is back of the enterprise.

MT. CLEMENS, MICH.—Three townships have granted franchises to the Peninsular Electric Light Company of Detroit, to run its high-tension wires through the townships. The objective point of the company is Port Huron, where light will be furnished from the Detroit power house at Detroit prices. Resorts along the lake shore will also be supplied.

GRAND RAPIDS, MICH.—The capital stock of the Grand Rapids-Muskegon Water Power Electric Company has been increased from $1,000,000 to $2,000,000 and a bond issue of $5,000,000 authorized at a meeting of the company held at Portland, Me. Work is being pushed on the big dam near Big Rapids and right of way for pole lines is being secured. Contracts for business are being negotiated in Grand Rapids and Muskegon.

BROWNS VALLEY, MINN.—A committee has been appointed to investigate the question of constructing an electric light plant.

PONTOTOC, MISS.—The citizens have voted to issue bonds for the construction of an electric light plant.

JACKSON, MO.—Bids will be received until Aug. 7 for $27,000 water and light bonds. Wm. Paar is city clerk.

JOPLIN, MO.—The Spring River Power Co. is about ready to let contract for the construction of a 4000-hp. steam plant.

SKIDMORE, MO.—The question of lighting this place by electricity is under consideration.

NEWMAN'S GROVE, NEB.—At a special election the proposition to issue $6,000 bonds for the purpose of establishing a lighting plant was carried.

RENO, NEV.—The Washoe Power & Development Company has closed a contract with the Stanley Electric Manufacturing Company for a second 750-kw., 2,300-volt, 3-phase, 60-cycle generator. The plant is operated by water power, transmitting current a short distance to Reno.

NASHUA, N. H.—At the annual meeting of the stockholders in the Nashua Light, Heat & Power Company, the stockholders voted to increase the capital stock to $600,000, an increase of $100,000.

TROY, N. Y.—The Troy Gas Co. is going to put in several miles of underground electric light circuits.

TONAWANDA, N. Y., has given up gas entirely for its streets. The price paid for arc is $70 per year and $20 for incandescents.

NORTH TONAWANDA, N. Y.—The Tonawanda Power Co., of North Tonawanda, has secured the contract for lighting the city, at $75 per arc light per year for a term of two years.

YONKERS, N. Y.—The Empire State Gas & Electrical Company has a capital of $50,000 and the incorporators are W. H. Cooper and N. R. Fox, of New Rochelle; C. J. Van Syke, of New York. It is intended to furnish gas and electricity in Yonkers and Mount Vernon, East Chester, Scarsdale, Tuckahoe and Bronxville.

MOREHEAD, N. C.—The town of Morehead has opened bids for a small electric light plant.

HENRIETTA, N. C.—The Henrietta Mills are completing a 1000-hp. electric drive at the cotton mills.

CHARLOTTE, N. C.—The Southern Power Company paid, according to reliable estimates, about $175,000 for the Mountain Island power on the Catawba River.

YADKIN, N. C.—Engineer J. M. Bandy completed a partial survey looking to the development of the Yadkin River by the Southern Yadkin Development Company, the estimated cost being $2,000,000. The power is estimated at 3000 horse-power. The company proposes to build a large cotton mill and supply power to High Point, Salisbury and other towns in the section named.

TURTLE CREEK, PA.—A new operating concern, known as the Rose Hill Electric Company, is in the field.

LEWISBURG, PA.—Philadelphia capitalists have purchased the plant of the Lewisburg Gas & Electric Co. and will make some improvements.

HARTSVILLE, S. C.—There is some talk of constructing an electric light plant here.

BELLE FOURCHE, S. D.—The Belle Fourche Power & Water Company has secured a franchise for an electric light plant.

BOLIVAR, TENN.—Bids will be received until Aug. 10 for furnishing material and machinery required for the proposed water and light plant. Specifications may be secured from Granbery Jackson, engineer, Nashville, Tenn. R. C. Wilkinson is the mayor.

WHITNEY, TEX.—Collier Bros. are interested in the construction of an electric light plant at Whitney.

MONTPELIER, VT.—The Consolidated Lighting Company is to increase the size of its plant at Montpelier and will install a 1,000 horse-power steam turbine and generator.

STAMFORD, VT.—The Stamford Light, Heat & Power Company has elected these officers: President, James D. Hunter, of North Adams; vice-president, H. T. Cady, of North Adams; treasurer, Col. F. S. Richardson, of North Adams; clerk, C. D. Houghton, of Stamford.

PULASKI, VA.—Bids will be received on Aug. 15 for the construction of a building and for new machinery and a 150-kw. dynamo. The present plant, 75-kw. dynamo, engine and boiler, will be offered for sale as soon as new plant is completed.

WHEELING, W. VA.—Mr. W. C. Handlan, of this city, has obtained control of the Ohio Valley Electric Light & Power Company of Benwood. This company was lately consolidated with the Home Electric Company of McMechen and the Benwood & McMechen Light Company. The capital stock is $50,000. A meeting of the stockholders will be held Aug. 4.

GRANITE FALLS, WASH.—O. Lewis, of Snohomish, has secured a franchise for an electric light plant.

WINNIPEG, MAN.—The Civic Power Committee has selected Cecil B. Smith to make preliminary investigation of the various sources of power available for the use of Winnipeg.

CHATHAM, N. B.—Steps are being taken to refit and enlarge the electric light plant at a cost of $35,000. Engineer Kelch, of Montreal, is preparing a report.

OTTAWA, ONT.—The plant and the assets of the Consumers' Electric Company have passed into the hands of the corporation of Ottawa. The deeds were handed over, the purchase price of $200,000 paid and formal possession of the property was taken by Mayor Ellis. The authority of the company ceases, the directorate dissolves, and hereafter the plant is intended to be operated as a municipal utility.

The Electric Railway.

BIRMINGHAM, ALA.—Bessemer citizens have organized a company to construct and operate an electric railway around the various suburbs of this place. The new line is intended to extend to Jonesboro, Dolomite, Ensley, Thomas and other mining and manufacturing camps in the lower part of the county. It will be used later on as a branch of a line to Tuscaloosa County.

TROY, ALA.—Troy people propose to build an electric railway from Troy to Elba, to locate the power plant at Elba on Pea River and to furnish power for manufacturing enterprises all along the line. A stock company, with $100,000 capital, one-half of which has been paid in, has been organized. Col. Charles Henderson and Capt. Hansford D. Boyd, of Troy, have associated with them others in the incorporation. J. M. Garrett, of Elba, is president, and Y. W. Rainor is vice-president.

TUCSON, ARIZ.—An electric street railway system will be built in Tucson by W. S. Iliff and C. K. Durbin, president and vice-presidents, respectively, of the United States Light & Traction Company, of Denver.

HARTFORD, CONN.—At the annual meeting of the Hartford & Springfield Street Railway Company, held in Hartford, it was voted to purchase the Rockville, Broad Brook & East Windsor Road and to build the same at once. The directors of the latter road met later and ratified the sale. The contract for building was awarded to the National Construction & Building Company, of New York. Officers were elected by the Hartford & Springfield Company as follows: William A. Tucker, president; Arthur Perkins, secretary; Chauncey Eldridge, treasurer; Henry S. Newton, superintendent. The stockholders of the Hartford & Springfield Street Railway Company voted to increase the capital stock by issuing 2,000 shares of the par value of $100 each, making the whole number of shares 7,000 and the whole amount of capital stock $700,000.

WASHINGTON, D. C.—Plans are on foot, it is stated, for the building of an electric railway that will connect points in Fauquier, Loudon, Fairfax and Alexandria counties, in Virginia, with this city. The charter was recently granted by the Virginia Corporation Commission to the new company. M. E. Church, of Falls Church, is the president of the proposed road, and among those interested is ex-Senator John B. Henderson.

CHICAGO, ILL.—The Chicago City Railway Company has decided not to build a new power station for the present, but to buy power from the Commonwealth Electric Company. Sub-stations will be established at Twentieth and State Streets and at other points, which will be supplied with power at 9,000-volts, 25-cycles, three-phase from the large steam turbine plant of the Commonwealth Electric Company at Fisk and Twenty-second Streets.

INDIANAPOLIS, IND.—The Huntington, Columbus City & Northwestern Railway Company has in contemplation a plan for building an electric railway from Indianapolis through Elwood, Marion, Huntington, Columbus City, Syracuse and Goshen. The contract for engineering, financing and building the road has been placed with the American Engineering Company. The officers of the company are Benjamin Raupfer, Columbia City, president; J. P. Dolan, Syracuse, vice-president; W. H. Magley, Columbia City, secretary; W. F. McLallen, treasurer; Melvin Blain, auditor; A. F. Weist, Jr., Columbia City, general manager; John A. Shafer, Indianapolis, chief engineer.

COUNCIL BLUFFS, IA.—The promoters of the proposed electric railway from Council Bluffs to Griswold have organized temporarily with H. H. Van Brunt as president. The company will be reorganized and the capital stock fixed after the survey is completed. The backers of the project are now preparing to go before the City Council and ask for a franchise to use certain streets.

DAVENPORT, IA.—There is another project on foot for the construction of an electric railway to connect Iowa City and Davenport. Three companies have already been formed for this purpose, all of which have made surveys. No construction work has been done by any of the three as yet. Now the business men of Davenport, recognizing the benefit to be derived from such a line, have had a survey made, and are promoting the constructibn of such a line.

DES MOINES, IA.—The Central Railway Company has been organized in this city for the purpose of constructing and operating electric interurban railways in Iowa and other states. The capital stock of the company was fixed temporarily at $25,000, and Des Moines will be headquarters. The first proposed line under consideration is one from Des Moines to Ames, a distance of about 37 miles. The officers of the company are: Thomas J. Wilcox, of Clinton, president; L. E. Miley, of Chicago, vice-president; B. S. McCully, of Princeton, treasurer; D. L. Wilcox, of Des Moines, secretary, and George H. Carr, of Des Moines, attorney.

SOMERSET, KY.—Dr. W. Godfrey Hunter has closed a deal for the Somerset Water Works Company for $150,000. He is negotiating for the electric light plant and the street railway franchise, and has announced that he will erect a central street railway station in the Public Square.

PADUCAH, KY.—The public service utilities of Paducah, controlled by the Paducah Steam Heating Company, have been purchased by Stone & Webster, of Boston. The purchase price is said to have been $1,440,000, divided as follows: The Paducah City Railway Company, capital $300,000, bonds $650,000, 14.9 miles of track; Paducah Gas & Fuel Company, capital $200,000, bonds $100,000; Paducah Steam Heating Company, capital $100,000, bonds $50,000. The new owners are said to plan improvements that will aggregate several hundred thousand dollars.

LEXINGTON, KY.—Another company, with the object in view of building interurban electric lines to connect this city with surrounding towns, has been formed by local capitalists. It will be known as the Lexington Southern Railway Company. The capital stock of the company will be placed at $3,600, and the incorporators will be J. Will Stoll, Richard C. Stoll, Ernest B. Ellis, William E. McCann, Leonard G. Cox, Rudolph R. Harting and D. Gray Falconer. The purpose of the company is to construct an electric railway between Lexington and Nicholasville, and to furnish heat, light and power. The officers of the corporation will be: J. W. Stoll, president; D. Gray Falconer, vice-president; E. B. Ellis, secretary and treasurer.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company directors have voted to authorize P. H. and P. C. Dolan to build a new power house upon the recently-purchased Seymour Street property. The new plant will cost about $100,000. Engineer C. K. Stearns, of Boston, is preparing the plans.

BENZONIA, MICH.—The Business Men's Association is seeking to interest capital in a project for the building of a 20-mile electric railway along the shores of Crystal Lake, connecting the resorts, through Benzonia to Beulah and Honor.

SAULT STE. MARIE, MICH.—Sheridan F. Masters, speaker of the Michigan House of Representatives, and Game Warden Chapman are promoting a project for building an electric railway between the Soo and Bay City. A through sleeper service is to be a feature. The road will cost $350,000 to build, and will traverse a rich farming section.

SYRACUSE, N. Y.—The Syracuse, Lakeside & Baldwinsville Railroad, the 14-mile line extending north from Syracuse along Onondaga Lake to Baldwinsville, will be sold at auction.

ELMIRA, N. Y.—The Delaware, Lackawanna & Western Railroad has bought the Elmira & Seneca Lake Railroad's line between this city and Watkins.

ALBANY, N. Y.—At its July meeting the board of directors of the United Traction Company failed to declare the quarterly dividend. Stockholders believe that the passed dividend will be declared in August.

CLINTON, N. Y.—F. K. Baxter, of Utica, has completed maps and profiles for an electric railway from Clinton to Waterville, a distance of 11 miles, and in connection with the same he has completed estimates for water power to generate the necessary electric power.

ROCHESTER, N. Y.—The Rochester & Southern Construction Company has been incorporated at Albany with a capital of $100,000 to build an electric railway from Elmira to Rochester. The officers of the company are William A. Cullen, of Newark, N. J., president; Thomas Barker, of Rochester, vice-president; T. S. Mulcahy, of Rochester, secretary; George A. Engert, of New York City, treasurer and manager.

ITHACA, N. Y.—The Auburn & Ithaca Traction Company is petitioning the Board of Aldermen of this city for a franchise to construct its track through Cayuga Street. According to the engineer's plans, the Ithaca terminus of the road will be at the Cayuga Street bridge over Six-Mile Creek. Officers of the company have been elected as follows: Sherman Collins, of Ithaca, president; J. P. Hazard of Poplar Ridge, vice-president, and E. B. Mosher of Auburn secretary and treasurer. Hearings on the proposed railroad are to be given by the State Board of Railroad Commissioners soon—one in Auburn and the other in this city.

CLEVELAND, OHIO.—C. H. Hubbell and others have formed the Cuyahoga Traction Company, and propose to build a suburban line from South Brooklyn, through Parma and Middleburg, to Berea.

INDIANAPOLIS, IND.—The Indianapolis & Ohio Valley Traction Company, which proposes to build from Indianapolis to Evansville, is making good progress in securing rights of way and franchises in and through the counties and cities along the proposed line. The company is agreeing not to charge more than 1¼ cents a mile.

MUNCIE, IND.—The Muncie, Hartford City & Fort Wayne Traction Company refused to accept its own price of $2,500,000 for 40 miles of road, which connects this city with Bluffton. The company has instead decided to build to Fort Wayne, regardless of what the Fort Wayne & Wabash Valley Company does. Both companies are constructing grades, and indications point to two lines connecting Bluffton with Fort Wayne. It is said that the Indiana Union Traction Company is back of the Fort Wayne enterprise in order to get a through line from Fort Wayne to Indianapolis.

EATON RAPIDS, MICH.—Because of the attitude of the citizens of Mason in refusing to give the Jackson-Lansing Electric Railway Company a franchise through the streets desired, it is probable that the road will come through Eaton Rapids and avoid Mason. That city insisted that the road should run through the main street. This would make necessary the building of two overhead bridges at a cost of nearly $50,000. The road refuses to do this. Surveyors are now laying out the right of way through Eaton Rapids.

NIAGARA FALLS, N. Y.—The Niagara Falls and Lockport Electric Railway Company, Niagara Falls, has been incorporated; capital, $200,000. Directors: E. C. Lufkin, J. N. Bradford, Buffalo, and S. P. Franchot, Niagara Falls.

PATERSON, N. J.—The project to build an electric railway to Greenwood Lake is again being agitated. It is to start at Singac and go through Wayne, Mountain View, Pompton Plains and Pompton, where a branch will run to Butler, 4 miles distant. The main line will continue from Pompton to Midvale and Hewitt, past Coopers, the Lakeside and the Ferncliffe to the upper end in Orange County, N. Y. The line, according to the plan, would be about 25 miles long.

BROOKLYN, N. Y.—The property owners in Fulton Street having withdrawn their opposition to the construction of a four-track subway in that thoroughfare, the Rapid Transit Commission has notified the contractors to at once resume work, which was practically stopped a few weeks ago owing to the refusal of the property owners to give the necessary consent to the four-track road. According to the amended plans, there are to be four tracks under Fulton Street from the Borough Hall to Bond Street; five tracks from that point to Flatbush Avenue and six tracks under Flatbush Avenue to Fourth Avenue, the extra one a double decker branching off at Fourth and Lafayette Avenues.

TOLEDO, OHIO.—The Toledo, Defiance & Southern Railway Company, of Defiance, has been incorporated with a nominal capital of $10,000, by A. K. Detwiler, T. T. Ansberry, L. R. Schenck, W. H. Edwards and P. Kettoning.

LIMA, OHIO.—Contractor Cliff Wise, of Lima, has closed a contract for the construction of 36 miles of road between Muncie and Portland, Ind. The work is for the McCullogh interests, which are said to be backed by the Widener-Elkins syndicate.

YOUNGSTOWN, OHIO.—Horace T. Smith, of Youngstown, and Robert L. Walker, of Poland, are forming a company, and have secured a right of way for the purpose of building an electric railway from Youngstown to Poland, a distance of about 8 miles.

HAMILTON, OHIO.—According to general manager Sloat, of the Cincinnati Northern Traction Company, the central power house that is to be erected in that city will cost $700,000. There will be three turbo-generators of 1000-kw. capacity each, and three 300-kw. rotary converters. There will be four substations.

COLUMBUS, OHIO.—The reorganization of the Columbus, Delaware & Marion Electric Railroad Company has been effected through the consolidation of that company with the Columbus Northern Railway, Power & Equipment Company. The last-mentioned company was formed to build a power house and improve the electrical equipment. The new company is known as the Columbus, Delaware & Marion Railway Company. It has a capital stock of $2,500,000 and a bonded debt of the same amount.

GUTHRIE, O. T.—The United Trolley Improvement Company, of Guthrie and New Jersey, with $1,000,000 capital stock, has filed its charter here. The incorporators are Ernest T. Preston, of Monmouth County, N. J.; Ernest T. Andrews, of Norfolk County, Mass., and H. W. Pentecost, of Guthrie.

EASTON, PA.—An Easton (Pa.) dispatch says a combination of trolley lines to cover 100 miles in Northampton County, which includes the lines from Walnutville to Danielsville, Nazareth to Bath, and Bethlehem to Bangor has been effected. E. B. Smith & Co., of Philadelphia, who control the Easton Transit Co., are said to be interested in the merger.

HARRISBURG, PA.—The State Department has issued charters to seven new street passenger railway companies in the vicinity of Pittsburg, with a total capital of $100,000. They are as follows: The Ambridge, Edgeworth & Sewickley; Ambridge, Sewickley & Osborn; Ambridge, Dixmont & Emsworth; Ambridge, Osborn & Haysville; Ambridge, Haysville & Glenfield; Ambridge, Glenfield & Dixmont; Ambridge, Leetsdale & Edgeworth.

PITTSBURG, PA.—The Pittsburg Railway Company has purchased the Beaver Valley Traction Company, and the following officers representing the new control have been elected: President, J. D. Callery; vice-president, S. L. Tone; secretary, W. B. Carson; treasurer, C. J. Braun, Jr.; assistant secretary and assistant treasurer, J. C. Lightfoot, Jr.; general manager, Gaylord Thompson. The Pittsburg Railways Company pays approximately $1,000,000 for the $1,095,000 (par value) Beaver Valley Traction Company stock and guarantees principal and interest on the outstanding bonded indebtedness.

AUSTIN, TEX.—The Gainesville, Whitesboro & Sherman Electric Railway, capital $500,000, with principal office at Gainesville, has been chartered. The incorporators are G. A. Hassinger, H. L. Lazarus, of New Orleans; H. G. Stinnett, of Sherman; O. B. Cowell, of Whitesboro, John King, and others, of Gainesville.

New Industrial Companies.

THE N. E. ELECTRIC CLOCK COMPANY, of Bangor, Me., has been formed. Capital, $100,000. President, P. S. Smith; treasurer, W. L. Curran. Directors, as above and A. M. Robinson and A. G. Curtis, all of Bangor.

THE B. & B. APPARATUS COMPANY, of Kittery, Me., has been organized for the purpose of manufacturing and dealing in electrical apparatus. The capital stock is $120,000, of which nothing is paid in. The officers are: President, Harold P. Knowlton, of Malden, Mass.; treasurer, Jesse E. Forsyth, of Kittery.

THE ST. JOHNSBURY ELECTRIC COMPANY, which has been engaged in the electrical business in St. Johnsbury, Vt., has filed articles permitting it to buy and sell water powers, real estate and personal property, conduct electric light plants and maintain stores for the sale of electrical lighting and wiring apparatus.

Legal.

CHICAGO STREET RAILWAYS.—The Chicago City Railway has filed a bill in the United States Circuit Court for an injunction to restrain the city of Chicago from interfering with any of the company's lines.

THE WESTERN UNION ON THE RAILROADS.—The Western Union Telegraph Company has asked the United States Court at Indianapolis for a perpetual injunction restraining the Vandalia Railroad Company from interfering in any way with the company's lines along the right of way of the defendant. On Jan. 18 last the Vandalia Railway Company notified the Western Union that it must cease using the right of way by Feb. 1, 1906, when the contract between the two corporations expired, and if such use was not discontinued by the time stated the lines would be severed.

Obituary.

J. C. CHAMBERLAIN.

MR. J. C. CHAMBERLAIN.—It is with deep regret that we record the sudden death last week from bronchial pneumonia of Mr. Jacob Chester Chamberlain, a well-known electrical engineer. Early in the week his friends heard of an indisposition, and were stunned at the swift and fatal march of disease. Mr. Chamberlain was born in India of American parentage on July 3, 1860, being the son of Jacob Chamberlain, M. D., D. D., and in 1872 was brought to this country to complete his education. He graduated with honors from Rutgers College, New Brunswick, N. J., in 1882. In 1883 he took a post-graduate course in chemistry; soon after he entered Mr. Thomas A. Edison's laboratory, on Goerck Street, so that he took an active part in the pioneer electric lighting work of those days. He was engaged as electrical engineer in the historic first Edison electric light station on Pearl Street, and during his connection with it he devised a number of improvements for locating grounds in the street feeders which at that time occurred frequently. About 1886 he was engaged by Mr. Henry C. Davis, then president of the Sawyer-Man Electric Co., as electrical engineer and superintendent of construction. Some of his early installations were the electric lighting of the United States Capitol, the Hudson River Tunnel, which up to that time used candles; the Mutual Life Building and other conspicuous plants. He then became deeply interested in traction, and in 1889 was engaged as electrical engineer of the Julien Traction Co., which was introducing storage battery cars. During his connection with that company he took out a large number of patents relating to the improvement and development of the storage battery system for railway work. Some of the patents relating to controllers were quite fundamental and were acquired by the General Electric Co. In connection with this work he developed and patented some special gears and pinions to reduce the loss which occurred in transmitting power from the motor to the car axle. The motors at that period were comparatively high speed, so that double reduction was resorted to. This involved the rapid depreciation of the pinion. A large business was done in this line until single reduction motors were brought out. About 1893 he took up his well-known work on electric launches, and during the next seven years so thoroughly developed the design, construction and equipment of such boats as to take them from the experimental condition and make them a recognized branch of electrical industry. Soon after, he obtained entire control of the Electric Launch Co., and during the next few years did a very satisfactory business. The Electric Boat Co., seeking to consolidate the different electrical interests in marine propulsion work, bought out his interests about 1900. During the next two or three years he confined himself to his private business. In the early part of 1904 he became general manager of the Automatic Refrigerating Co., some of the directors of the company being very well-known and largely identified in electrical enterprises. He had just succeeded in developing and putting the automatic refrigerating work on a practical and reliable basis and was arranging to push the introduction of the automatic refrigerating

system in the market when his sudden and fatal illness overtook him. This system was recently illustrated and described in our pages. Mr. Chamberlain received the degree of Master of Science in the early part of his electrical career; he was also one of the early members of the American Institute of Electrical Engineers. He was a member of the old Electric Club and later became the chairman of the house committee. He was also a member of the Colonial Club, the Marine Field Club and a very active member of the Grolier Club, he being considered a specially good authority on first editions of early American authors, his complete and valuable collection of their works being considered by experts one of the best in the country. Mr. Chamberlain was a member of the Engineers' Club for many years, and at the time of his death was chairman of the house committee, a capacity in which he rendered brilliant and memorable service. He was also a member of the board of trustees of the club. The funeral services took place at the Collegiate Church on Fifth Avenue on July 30. Mr. Chamberlain left a widow and a daughter about nine years old. The grief of his family is shared by a host of long-time friends and admirers in all branches of the mechanical and electrical professions.

MR. H. R. PARRISH, for ten years confidential secretary to Mr. Theodore N. Vail and American representative of La Capital Tramways Company, of Buenos-Aires, Argentina, and the Rosario Electric Lighting Company, died on Friday, July 28, of rheumatism of the heart. Mr. Parrish was at one time connected with the Electric Storage Battery Company, of Philadelphia. He is survived by a widow and one child. Mr. Parrish was only 44 years old.

Educational.

STATE COLLEGE OF WASHINGTON.—Although the college was not founded until the year 1890 its growth has been so rapid that it is enabled at the present time to offer courses in practically all branches of learning. Instruction is given in mathematics, chemistry, botany, zoology, agriculture, English language, literature, economic science, history, mechanical engineering, electrical engineering, modern languages, mining engineering, geology, pharmacy, veterinary science, music, business, dairying, military science and tactics. The catalogue for the past college year shows a total registration of 793 students. The expenses of the institution are met by the income from endowment funds and by State appropriations, so that tuition is free to all residents of the State of Washington.

Personal.

MR. C. S. SERGEANT, vice-president of the Boston Elevated Ry. Co., is making a few weeks' trip of combined business and pleasure in Europe.

MR. W. B. RANKINE, of the Niagara power interests, has sailed for Europe on the steamer "Zeeland," for rest and recreation during the summer.

MR. WALTER E. HARRINGTON has resigned his position as vice-president and general manager of the New York-Philadelphia Company, and of its affiliated companies.

DR. HAROLD PENDER, who is associated with Dr. Cary T. Hutchinson, in New York City, was married recently, in Syracuse, to Miss Alice Campbell Matthews, of that city.

MR. S. W. LE BARON has become superintendent of the Electric & Gas Co., of Grand Junction, Colo. He was formerly the superintendent of the Albuquerque, N. M., Gas, Electric Light & Power Company.

GEN. A. B. P. SPRAGUE, president, and Mr. W. H. Coughlin, superintendent, of the Worcester, Mass., Electric Light Company, have recently returned from a trip to Philadelphia, Wilmington and Atlantic City, on technical matters.

MR. R. B. COREY, who has represented the Bossert Electric Construction Co., of Utica, N. Y., in the Metropolitan district, for its steel outlet boxes, switches and specialties, has been appointed sales representative for Southern New York, New Jersey, Pennsylvania, Delaware and the District of Columbia.

MR. DANIEL E. CARTER, assistant chief operator of the Boston office of the Postal Telegraph-Cable Company, has been appointed manager of the company's office at Springfield, Mass. Following the announcement of Mr. Carter's advancement, he was presented with a gold watch charm, studded with diamonds, the gift of his associates. The recipient's term of unbroken service with the Postal Company covers over 22 years.

MR. PAUL DOTY, general manager and second vice-president of the St. Paul Gas Light Company, has been elected president of the Ohio Gas Association. Mr. Doty is well-known in the electrical field, and his friends therein hasten to congratulate him upon this deserved recognition. His company is in virtual control of the electric lighting system in St. Paul, as it controls and operates the Edison Light & Power Co., the St. Paul Light, Heat & Power Co., and the East Side Electric Co., and leases the St. Croix River Co., a power transmission system. Mr. Doty was prominent at the recent National Electric Light convention at Denver.

MR. F. P. FISH.—President Fish, of the American Telephone Company, has returned from a trip of several weeks to the Pacific Coast and intermediate points. Mr. Fish says: "On every hand I saw evidences of normal, healthful growth. Business in the west and northwest is very good. There are no evidences of an unnatural boom, but business men and farmers are all talking confidently regarding the general business situation. I found that our western telephone managers are displaying the same energy in the development of their fields as is shown in the east. Of course, I found competition in various parts of the west. This is, of course, annoying, but not disturbing. Crops are looking very well indeed, in fact, I never saw Nebraska looking better."

MR. JOHN SPEICHER, chief of the fire department telegraphs of Jersey City, N. J., is making an effort to hold or recover that position. He started the department's telegraph service, and had been its Superintendent at $2,500 per year for more than twenty years, when, some months ago, charges were made against him. As soon as he was accused, a letter resigning his position reached the Fire Board, and he dropped out. He was brought back and put on trial. The testimony of the complainants was so contradictory that Judge Blair directed an acquittal, but the jurymen declared their belief that he was guilty and refused to obey the court's direction, and the court finally ordered the Clerk to record the verdict of "Not guilty" in the face of their protests. Meanwhile the Fire Board had taken Speicher's brother Mahlon from a similar position in the Police Department and appointed him to the vacant Superintendency. At its last meeting the acquitted ex-Superintendent surprised the Fire Board with a letter declaring that he had not resigned or authorized any one to present his resignation to the board, protesting against the "intrusion" of the other Speicher into the place, and demanding that the board dispossess his brother and recognize him as the lawful incumbent of the office. The board declared that, as it had accepted Speicher's resignation, it did not see how it could retrace its steps, but referred the letter for advice to Corporation Counsel Record. Mr. Speicher does not charge that his resignation is a forgery, but intimates that after he had written it he held it under advisement, and that while he was considering it some one carried it to the Fire Board's office and filed it.

MR. W. M. PROBASCO, the well-known technical journalist, has resigned as assistant to the president of the McGraw Publishing Company to accept the office of vice-president of the Search Light Publishing Company, of New York City, a unique organization which promises to occupy an important field in the journalistic and publishing business of this country. The company owns a file of about 2,500,000 clippings, articles and pictures on all subjects, compiled from newspapers, magazines, engineering journals, books and reports of scientific societies, classified and kept up-to-date for the use of all who require prompt and up-to-date information on any subject. As a part of its plan also the company publishes a weekly paper called *The Search Light*, which is a record of the most important events of the previous week and which covers some sixty separate departments. As a nucleus for this paper the company purchased *The Great Round World* and *The Week's Progress*, publications somewhat on the line of its own, but has improved on their plans and especially in the completeness with which the information is compiled and indexed. The company also handles the publishing and advertising accounts of important railroad, mechanical and engineering firms. The fourth department of its business is the publication of books. One of those in hand is one on Cuba and another deals with the exhibits of the Westinghouse Companies at the recent International Railway Congress. Mr. Probasco was formerly assistant general manager of the Westinghouse Companies' publishing, advertising, and exhibition interests, and in this capacity was the designer and organizer of the Westinghouse exhibits at the St. Louis Exposition, which received the grand prize as an exhibit. He was also compiler and editor of the handsome monograph recently issued for the Interborough Rapid Transit Company by the McGraw Publishing Company. Associated with Mr. Probasco in the enterprise is Mr. E. G. Handy, who with his brother had charge of the Bureau of Publicity and Promotion, of the Chicago World's Fair, and has since been a prominent newspaper man and publisher; and Mr. W. G. Jordan, who was six years editor of *Current Literature*, was later managing editor of the *Ladies' Home Journal* and subsequently editor-in-chief of the *Saturday Evening Post*, of Philadelphia.

Trade Publications.

STEAM ENGINES.—The Ball Engine Company, Erie, Pa., has just gotten out a well illustrated booklet describing side-crank, single-cylinder and Corliss engines. The side-crank engines are particularly adapted for direct connection to generators. These engines are built in the simple, or in the tandem-compound or cross-compound types. The Corliss engines are constructed in either the horizontal or vertical types, in sizes up to 1,200 horse-power.

WALLACE BARNES & CO., of Bristol, Conn., manufacturer of small springs of every description, and dealer in wire and cold rolled steel, has issued a very neat pamphlet in regard to its specialties, many of which are a necessity in various branches of the electrical arts. The catalogue not only contains illustrations and descriptive data, but a good deal of technical information and several useful tables. The cuts are singularly good and helpful in showing what the concern makes.

SINGLE-PHASE INDUCTION MOTORS.—Bulletin No. 87 of the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., describes a line of self-starting single-phase induction motors. These machines are made in two sizes: one-fifteenth and one-tenth horse power respectively. Each is provided with a centrifugal clutch, so arranged that the motor will automatically start its full load. Each motor is provided with a starting coil which is cut out automatically when full speed has been attained.

News of the Trade.

PASS & SEYMOUR, INC., announce that it is their intention to materially increase their facilities for handling orders in the territory covered by their Chicago office, and to this end have secured the services of Mr. W. F. Hessel, formerly sales manager of the Western Electric Co., at Chicago. Mr. Hessel's long experience and intimate acquaintance with the materials and needs of the electrical business are of such a character that they are more than pleased to announce his association with them, and wish to advise their customers that they want them all to feel at liberty to call upon him at any time for information not only regarding their superior line of electrical specialties, but also regarding any problem of a general nature on which his past experience will be of service. Mr. Hessel's headquarters will be at 130 West Jackson Blvd., Chicago, Ill.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY.. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelphia. Next meeting, Bethlehem, Pa., Sept. 18, 19 and 20, 1905.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next convention, Philadelphia, last week in September, 1905.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION.. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Glenwood Springs, Col., Sept. 18, 19 and 20, 1905.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA. Secretary, S. J. Fuller, Larimore, N. D.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 16, 1906.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, D. Davis, Litchfield, Ill. Next meeting, Peoria, Oct. 5 and 6, 1905.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Erie, Pa., Aug. 23, 24 and 25, 1905.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

IOWA ELECTRICAL ASSOCIATION. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION.. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Oct. 14 and 15, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION.. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Oct. 10, 1905.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary Frank S. Leach, Sedalia, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in Jan., 1906.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Hotel Victory, Put-in-Bay Island, Aug. 16, 17 and 18, 1905.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION.. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa. Next meeting, Pittsburg, September, 1905.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, jr., 114 Liberty St., New York.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STREET RAILWAY & ELECTRIC ASSOCIATION. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 25, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

794,981. TIME LIMIT CONTROLLER FOR CIRCUIT BREAKERS; Edward M. Hewlett, Schnectady, N. Y. App. filed June 23, 1903. A single instrument is adapted for use with a plurality of circuits. Each circuit has a magnet-controlled gear segment which is engaged with a continuously rotating worm under conditions of excessive current. After a certain time the rotation is sufficient to open the circuit. If the excessive current is not of sufficient duration, the worm and gear segment will be disengaged before the circuit is opened.

795,285. SWITCH; William S. Jackson, of Hoboken, N. J. App. filed August 27, 1904. A trolley switch in which a swinging bar depends from a portion of the trolley wire so as to be moved in one direction or the other by the trolley wheel, thereby throwing an appropriate switch. The bar serves to guide the trolley wheel while the parts are in contact.

795,312. RECEIVING APPARATUS; Harry Shoemaker, of Jersey City, New Jersey. App. filed Feb. 13, 1905. A detector for wireless telegraph systems in which a galvanic cell is employed in place of the usual coherer. The antenna element of the cell is extremely small and is made of fine platinum wire, coated with silver. An excitant of sulphuric or nitric acid is used.

795,313. SELF-PLAYING MUSICAL INSTRUMENT; Harold W. Shonard, of Newark, N. J. App. filed May 22, 1900. Relates to the control of automatic piano players and involves features to prevent sparking of the contacts at the perforated sheet, and means for modulating the tone of the instrument. Employs a plurality of "vails," which are independently actuated to simultaneously make a series of contacts to vary the volume of tone of certain ranges of notes.

795,314. SIGNALING SYSTEM; Howell W. Souder, of Tamaqua, Pa. App. filed Sept. 27, 1904. A signaling system adapted to protect a single track section into which a plurality of cars are admitted, and in which the signal is not cleared until all the cars have left the block. Has a star-wheel which is stepped around in one direction or the other by separate operating magnets.

795,318. ANNUNCIATING MECHANISM. Charles E. Trump, of Philadelphia, Pa. App. filed July 28, 1904. A system for use in hospitals, in which a signal is displayed at a patient's room until answered, and a corresponding annunciator is operated in the superintendent's office.

795,322. RAILWAY BLOCK SIGNAL SYSTEM; Ludwig S. Walle, of Brooklyn, N. Y. App. filed Dec. 29, 1903. An overlap system in which the usual track rails are employed. Pole changers are included in the apparatus at each station, so as to secure the overlap. The semaphore arm has a sprocket wheel and chain and a series of solenoids are successively energized to move the chain and set the semaphore arm.

795,323. APPARATUS FOR ELECTROTHERMAL TREATMENT; Daniel M. Watson, of Portland, Ore. App. filed Dec. 7, 1904. A sort of crit or frame has two hinged sections, with rows of incandescent lamps thereon, and can be folded together so as to enclose a patient.

795,325. GALVANIC BATTERY; D. L. Winters, Chicago, Ill. App. filed Nov. 2, 1904.

795,340. CIRCUIT CLOSER; Eugene R. Carichoff, of East Orange, N. J. App. filed August 25, 1900. The circuit is broken at carbon contacts after the metallic knife blade contacts have been separated, and a pair of electric magnet coils are automatically thrown in the circuit to blow out the arc at the carbon contacts. The switch is actuated by a solenoid.

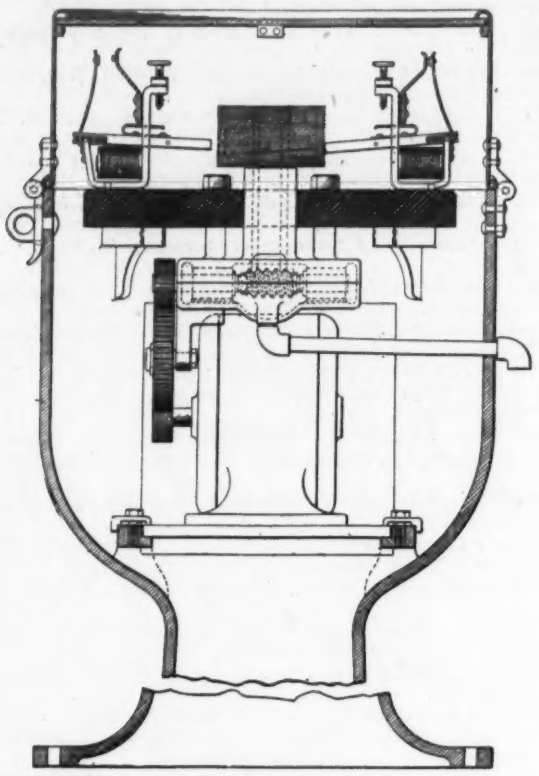
795,369. AUTOMATIC CONTROLLER; Ernest Schattner, of Schenectady, N. Y. App. filed July 8, 1904. An apparatus to warn a consumer that he is using more than the contract number of lamps. The excessive current energizes a solenoid which switches a single display lamp in series with all the other lamps, dimming the latter and indicating the reason for the disturbance. Means are provided for rendering the controller inoperative when desired.

795,392. AUTOMATIC REGULATOR FOR ALTERNATING CURRENT MOTORS; G. H. Hill, Schenectady, N. Y. App. filed Jan. 15, 1904. (See Current News and Notes.)

795,402. TELEGRAPH AND LIKE CABLE; Oliver J. Lodge, of Birmingham, England. App. filed Dec. 9, 1904. In order to avoid the sluggish action of the usual submarine cable, the electrostatic wave is dissipated

and the electromagnetic wave strengthened. For this purpose the conductor is surrounded by an iron sheathing of high magnetic permeability, and a comparatively poor insulator is used so as to dissipate the electrostatic charges.

795,432. POLARIZED ARMATURE APPARATUS; Martin Fischer, of Zurich, Switzerland. App. filed Sept. 1, 1904. An electromagnet has bevelled holes so formed that a pivoted armature cannot lie against both



794,981.—Time Limit Controller for Circuit Breakers.

simultaneously. The poles are normally magnetized with same polarity by a permanent magnet. When current passes, one or the other pole is strengthened according to the direction of the current, and the armature correspondingly tilted.

795,436. SNAP SWITCH; Henry Geisenhoener, of Schenectady, N. Y. App. filed Feb. 19, 1902. A switch designed to secure a vibratory motion of the switch blades by rotary movement of the operating handle. The handle and switch blades have cranks of unequal length, which are connected by a link.

795,462. ELECTRIC CONTROL APPARATUS; William A. Turbayne, of Lancaster, N. Y. App. filed Sept. 15, 1904. Relates to controllers in which the rheostat arm is operated by the motor which runs the exciter. In order to prevent the drop in potential due to the extra load upon the motor, the exciter fields are included in series with the motor armature so that the extra current used will strengthen the exciter fields and compensate for the lower speed.

795,467. ELECTRIC TERMINAL BOND; Henry J. Wessinger, of Duluth, Minn. App. filed April 15, 1904. A copper bushing screw-threaded into the rail can be expanded therein by a conical plug, having a nut on its small end.

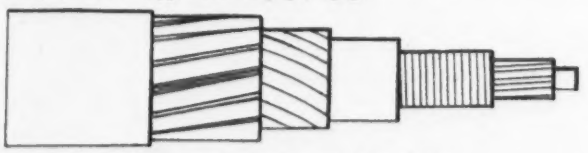
795,473. ANNUNCIATOR; S. B. Bankson, San Francisco, Cal. App. filed July 26, 1904.

795,481. DYNAMO ELECTRIC MACHINE; Henry Chitty, of London, England. App. filed April 11, 1905. Is designed to prevent distortion of magnetic field under heavy loads involving shifting of the commutator brushes. A series of iron sections are formed to bridge between adjacent pole pieces and shunt a portion of the magnetic field. These become saturated under normal loads so that they do not take an increased flux under heavy load conditions.

795,492. INCANDESCENT ELECTRIC LAMP; Timothy G. Dinneen, of St. Louis, Mo. App. August 6, 1904. The lamp has three and separate filaments each of each can be switched into circuit when the others have burned out.

795,512. ELECTRIC RAILWAY SIGNAL. Charles F. Hoover, of Lockport, N. Y. App. filed Jan. 12, 1904. The semaphore arm is moved by a solenoid magnet directly energized from an insulated section of the trolley wire. A mark is simultaneously made on a clock-driven paper strip so as to note the time of the actuation.

795,517. PROCESS OF PRODUCING TUNGSTEN STEELS; E. D. Kendall, Brooklyn, N. Y. App. filed May 31, 1905.



795,402.—Telegraph and Like Cable.

795,520. STRAIN INSULATOR; John S. Lapp, of Rochester, Arthur S. Watts and Walter T. Goddard, of Victor, N. Y. App. filed March 6, 1905. Is adapted to be supported by upper and lower cross beams so as to give greater strength against lateral strain. The insulator has triple porcelain petticoats above and below the conductor.

795,521. INSULATOR; John S. Lapp, of Rochester, N. Y. App. filed Feb. 20, 1905. Relates to modifications of the above, in which a central porcelain sleeve has an integral petticoat portion at one end and a separate annular petticoat piece which bears against the opposite end of the sleeve and is secured thereto.

795,532. SELECTIVE SIGNALING APPARATUS; F. R. McBerty, Evanston, Ill. App. filed April 4, 1901.

795,533. TELEPHONE EXCHANGE APPARATUS; F. R. McBerty, Evanston, Ill. App. filed Sept. 28, 1903.

795,538. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS. Joseph J. O'Connell, of Chicago, Ill. App. filed July 20, 1904. A lightning arrester in which a pair of carbon blocks are separated to the required gap by being imbedded in an insulating cement of sulphur. The blocks are separated a greater distance at their bases than at the spark gap, so as to avoid short circuiting by dust and moisture.

795,541. APPARATUS FOR ELECTRIC WELDING; John C. Perry, of Clinton, Mass.; William S. Perry, executor. App. filed March 23, 1901. A device for welding reticulated iron grills, etc., in which a pair of clamping jaws press together a plurality of portions of the grill at one time. The circuit is broken by the "average upset" of the weld.

795,551. SERVICE METER FOR TELEPHONE LINES; C. E. Scribner, Jericho, Vt. App. filed Sept. 26, 1904.

795,558. CUTOUT; Charles W. Snyder, of Hudson, N. Y. App. filed Nov. 15, 1904. It is designed to make an electric lamp glow dimly for a short time after the switch has been turned. A heat coil is cut into series with the lamp filament, and after a predetermined heating effect is effective to break the circuit altogether.

795,570. CURRENT CONTROLLER; Swen G. M. Anderson, of Chicago, Ill. App. filed Jan. 27, 1904. An arrangement of circuits for motor controllers in which resistances can be cut into series and parallel with both the armature and field circuits.

795,577. PRINTING TELEGRAPHY; George A. Cardwell, of New York, N. Y. App. filed Dec. 9, 1903. The different transmitting keys send currents of different polarity, strength, and wave form, and at the receiving end of the line the printing key operating magnets are energized only by a predetermined character of current. Each sub-circuit at the receiving end has at least three gaps which must be closed in a predetermined order to actuate the particular magnet.

795,600. SIGNAL SYSTEM; W. S. Franklin and W. R. Whitehouse, Bethlehem, Pa. App. filed April 18, 1905. (See Current News and Notes.)

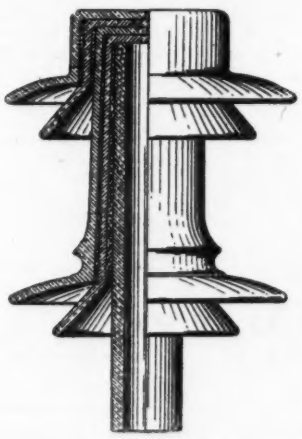
795,668. FLOOR BOX; David R. Waters and William McGuineas, of Chicago, Ill. App. filed July 20, 1904. A metallic casing is inserted in the floor and has a porcelain chamber therein in which are screwed the terminals. The plug is directed through a tube into the porcelain chamber.

795,670. ELECTRIC CONTROLLER; William R. Whitehouse, of Bethlehem, Pa. App. filed March 28, 1905. The controller arm moves through a complete circumferance and has a spring attached thereto to draw it to off position. A second spring prevents the arm stopping on a dead centre. The controller arm cannot be held in any position except by a special spring roller, which is effective only after certain predetermined motions of the arm.

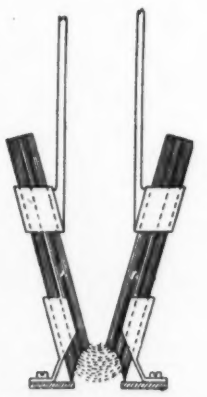
795,681. ELECTRIC ARC LIGHT; Heinrich Beck, of Meingen, Germany. App. filed Jan. 21, 1904. The carbon electrodes are directed toward one another at an acute angle. Both have longitudinal ribs on their outside edges which contact with a pair of supports so as to hold both carbons in a certain relation.

795,689. DEVICE FOR INFLUENCING ELECTRIC ARCS; Tito L. Carbone, Berlin, Germany. App. filed Jan. 31, 1905. The carbon electrodes are maintained at an acute angle to one another, and a magnetic field is created to direct the arc to the extreme outer ends of the electrodes.

795,726. ELECTRIC AND PNEUMATIC GOVERNOR; William H. Nightingale, of Philadelphia, Pa. App. filed July 16, 1904. A cut-out for air-pump motors in which the air-controlled diaphragm moves a contact arm having roller contacts thereon so as to obviate the effect of arcing. The motor cut-out switch is actuated by a solenoid in the usual way.



795,520.—Strain Insulator.



795,681.—Electric Arc Light.

795,747. RESISTANCE UNIT; Charles Wirt, of Germantown, Pa. App. filed Oct. 28, 1904. A pair of sheet metal parts are stamped to telescope together in a special way so as to form a ventilated support for the spiral resistance conductor, which is wound thereabout. Asbestos is interposed between the winding and the core.

795,762. WIRELESS TELEGRAPHY; Manuel R. Garcia, of Paris, France. App. filed Jan. 10, 1901. A system for sending wireless signals in a particular direction, in which waves are transmitted from a separate antenna at different points, so as to give a node or wave-interference in one direction.

795,780. ALTERNATING CURRENT MOTOR; Morris Milch, of Schenectady, N. Y. App. filed Jan. 2, 1904. Auxiliary field coils are energized at certain times so as to permit the brushes to be shifted to obtain increased generator action and to raise the power factor of the motor. The auxiliary windings generate an e.m.f. in the idle portions of the roter windings which neutralizes the self-induction therein.

795,789. ELECTROMECHANICAL SELECTING DEVICE; Richard P. Elliott and Anson G. Cox, of Boston, Mass. App. filed June 10, 1902. A typewriter or typesetting machine keyboard in which the keys are selected by dropping into aligned notches of six longitudinally movable bars, any desired permutation of which can be arranged by six electromagnets.

795,802. FIRE ALARM BOX; Patrick J. Corbett, of Albany, N. Y. App. filed Feb. 20, 1904. The act of turning the handle to send in an alarm throws together a pair of jaws which act as a handcuff to hold the person sending the alarm.

795,803. ELECTRICAL RESISTANCE; Elise Vedovelli, of Paris, France. App. filed May 23, 1904. A sort of fabric is built up by threading the resistance wire through small insulating beads so that the complete resistance is a reticulated structure having the appearance of a woven fabric.